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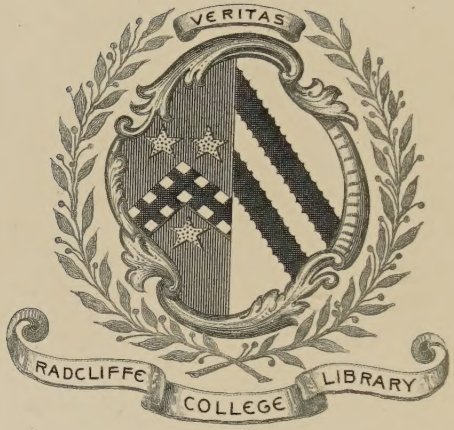

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RESEARCH STUDIES
III

TRENDS IN FOUNDRY PRODUCTION IN THE PHILADELPHIA AREA

TRENDS IN FOUNDRY PRODUCTION

IN THE

PHILADELPHIA AREA

BY

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PHILADELPHIA

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The Industrial Research Department of the University of Pennsylvania has made the contact with foundrymen more direct than was possible through the bank, with its many calls for other types of data, and has consequently brought the information closer to a review of the trade. Scarcely a month goes by without some foundry executive's questioning our figure of prices, our ratio of production to capacity, the representative character of the data or their applicability to the varying conditions of the foundry trade. In answering these friendly inquiries we are kept in direct touch with the industry and are given every opportunity to visit plants and discuss specific problems.

In making the data available, acknowledgment is made to the Philadelphia Federal Reserve Bank, to foundry executives and to the Metal Manufacturers' Association of Philadelphia. Credit is due to Miriam Hussey for criticism of the text and standardization of the presentation as well as to Majorie C. Denison for the drawing of charts and for assistance in the compilation of data.

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INTRODUCTION

The purpose of this study is to show the significance of changes in the trend of foundry production in the Philadelphia district. The study is concerned with the production of one of the basic industries in the manufacturing process. The industry may be said to serve all other industries. Its output fluctuates with every change in general prosperity. In fact, castings play a part in the manufacture of almost every commodity. If castings do not enter directly into the manufacture of the article, castings form part of the machinery which is used to manufacture the article.

A cursory examination of various leading industries shows the widespread use of foundry products. Textile machinery is one of the leading items in the output of several foundries in the area. Metalworking, woodworking and paper mill machinery use large numbers of castings in their construction. Hardly a manufacturing establishment in the country is at present operating without the products of some foundry.

The transportation industries also require castings in order to maintain and extend their services. The development of the railroads after 1830 created a demand for larger castings than had previously been made. This challenge was met by the foundrymen, and they have continued to supply a large tonnage of material for locomotive and engine works. The casting of car wheels has increased in importance until it is now almost a separate branch of the foundry industry. Shipbuilding plants either maintain their own foundries or purchase castings from jobbing firms for use as parts of machinery and as furnishings for ships. Automobiles depend upon castings for a large part of their engines.

The electrical industry consumes an increasing amount of foundry products. The Conowingo Dam Project on the Susquehanna used cast steel valves 27 feet in diameter.[1] The further development of either giant or super-power

[1] *The Foundry*, January 15, 1927, page 950.

plans will necessitate tons of castings for valves, housings, wheels, wickets and turbines. The use of electricity, in addition to its generation, employs castings. The most recent demand from this source has been that of the iceless refrigerator manufacturers. Previously other household machinery, especially washing machines and vacuum cleaners, had been using foundry products.

The building and construction industries furnish a large market for castings. The casting of stoves and radiators has been a distinct branch of the foundry trade ever since colonial times. The discovery of the centrifugal process of casting pipe has further intensified the specialization of cast iron pipe foundries. Much of the hardware that goes into houses, apartments, and office buildings comes from malleable and gray iron foundries.

Agriculture, which first felt the Industrial Revolution in an increased demand for farm products, has since adopted mechanical aids to production. Castings are essential as parts of agricultural implements such as plows, harrows and cultivators. The larger equipment, as typified by tractors and combines, is also dependent upon the foundry.

Other extractive industries demand castings. Dredges and steam shovels use castings for dipper teeth, frames, gears, racks, and parts of engines. Mine cars use cast wheels and bearings, and other conveying equipment depends also on castings. Drilling machinery is largely composed of parts which were originally produced in a foundry.

The widespread use of foundry products, the place of castings at the very start of the roundabout process of manufacturing, and the dependence of the industry upon the demand of other industries make foundry tonnage a very sensitive barometer of business activity.

The character of the foundry product restricts its market to a small geographical area. With a bulky commodity, of comparatively low cost, it is normally unprofitable to ship to great distances. Some of our foundries depend upon the business of the small center in which they are located. Even those which compete in a wider area may be said to depend

primarily upon the manufacturing activity of the locality. It is this limitation of market that gives especial significance to foundry data collected for specific localities.

Despite the wide use of foundry products and despite the fact that foundry output is of interest to industry in general as well as to foundrymen and to students of business conditions, no general index of foundry production is available and, so far as is known to us, this is the first study of identical gray iron foundries in any area.

*The Survey of Current Business** reports activities of gray iron foundries in Ohio as compiled by the Ohio State Foundrymen's Association. The reports from month to month are not from identical firms and the firms reporting vary in number from 40 to 70; thus any variations may be due merely to differences in the number of firms reporting. The ratio to "normal" as given is hardly comparable to our ratio of production to capacity because, first, it deals with meltings while our criterion is the production of good castings, and second, "normal" seems to be the average actual output for some period of time while our capacity represents the maximum amount which could be produced.

The Biennial Census of Manufacturers for 1925 gives no total figures for the production of gray iron castings. Most of the census figures are collected on the basis of type of product, and items such as cast iron pipe, stoves and radiators are listed under separate headings. In another section are given foundry and machine shop products not classified elsewhere. Even this does not include foundry products produced within a plant for its own use.

Adequate data are at present available from the malleable iron and steel branches of the industry. The Department of Commerce collects reports from identical firms covering most of the industry. Our figures on malleable iron and steel are mainly of interest in comparing the Philadelphia area with the country as a whole.

The data for this study, collected directly from foundries in the Philadelphia Federal Reserve District, include the

*Published monthly by the U. S. Department of Commerce.

monthly reporting of gray iron, malleable iron and steel foundries. No attention has yet been given to the non-ferrous branches of the industry, though the demand for brass, bronze and aluminum castings is steadily increasing.

The method of collection and the data upon which the analysis is based are given in the appendix. It is sufficient to note here that the monthly records cover production, shipments, unfilled orders and raw stocks of pig iron, scrap and coke on hand.

Though a figure of total output is not available, it is known that the 37 gray iron foundries and the 12 steel foundries participating in this study produce a substantial amount of each class of tonnage of castings made in the district. The area does not make a large amount of malleable castings and our record for four malleable iron foundries is more representative than might be inferred from the number of firms.

There are some duplications; two firms reported both gray and malleable iron, one both gray iron and steel, and one gray iron, malleable iron and steel.

The overlapping in the use of different raw materials in the same plant made it necessary to use a smaller group of firms for some of the comparisons. Consequently every chart indicates the number of firms included in each curve. For instance, the first chart in this study shows the tonnage of gray iron produced by 37 firms. The charts of indices of production and shipments include only the 33 foundries producing *gray iron castings* exclusively. By means of this classification, a more accurate comparison can be made between tonnage and value of shipments than would be possible if various grades of raw stock were included. Because all of the foundries were not able to report unfilled orders and raw stocks on hand, these data are used only for the group of plants with complete reports. This summary of the findings is presented in two parts: the first deals with the records of iron foundries, the second with those of steel foundries.

IRON FOUNDRIES

The Tonnage Produced in Gray Iron Foundries

Gray iron foundries, like most industries, show wide differences in operation from period to period. Normally there are seasonal peaks in March, June and October. Each year there is some tapering off in volume in midsummer and a distinct let-down in December or January. This seasonality is evident in Chart I, which shows in absolute figures the monthly tonnage of good castings in 37 foundries.

The curve of 1926 shows the highest rate of operation in recent years, with activity well sustained up to the very end of the year. In the early months of 1927 the market for castings was irregular, and the summer developed unusual dullness. A steady downward trend prevailed throughout the year, until by December the output for the month was only 4,500 net tons by the same firms which had reached a tonnage of 7,500 tons in the peak month of the previous year. These two years show the extremes of activity and inactivity.

Signs of improvement were evident in the early months of 1928, but it was six months before the monthly tonnage was brought back even to the low levels of the first half of 1927. Better demand characterized the last half of 1928 and the start of 1929. The rapidity of recovery in 1928 is indicated by the October production, which over-topped that of the same month in 1926. At the present time (May 1929) production is 7.8 per cent above the level of the same period in 1927 and 10.4 per cent above 1928, a record which approaches the high levels of the prosperous spring of 1926.

Two features impress one in connection with Chart I: the rhythmic seasonal changes, and the wide variations in the activity in the same foundries at different times. The fluctuation gives some idea of the heavy overhead for idle plant and equipment which has tended to limit the margin of profits

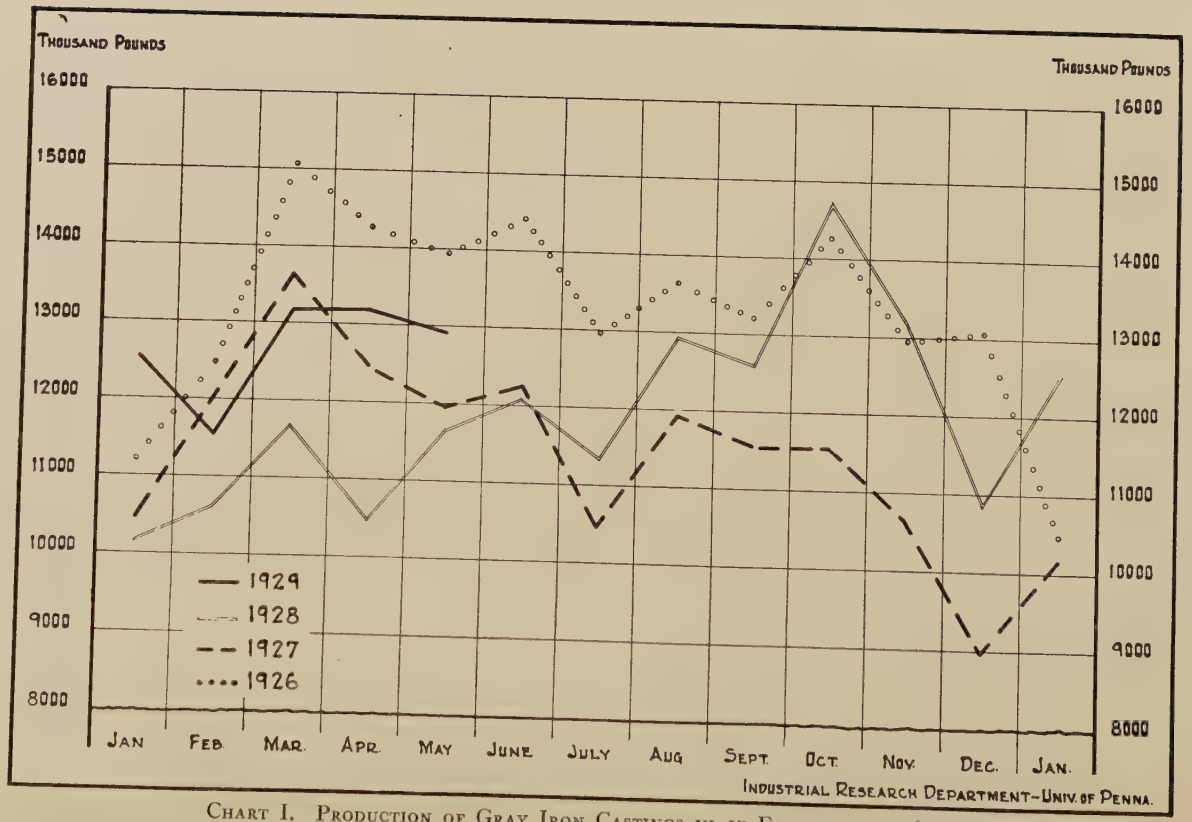

CHART I. PRODUCTION OF GRAY IRON CASTINGS IN 37 FOUNDRIES, 1926–1929

in a period of keen competition for orders. The chart on an absolute basis is useful merely in giving a general picture of the spottiness of production. Other factors can be more easily indicated by the use of relatives.

The Trend of Jobbing and Manufacturing Foundries

In Chart I the production of all types of foundries was combined. Foundries may be classified into *jobbing* concerns doing custom work, dependent wholly for their orders upon other industries, and *manufacturing* foundries, maintained primarily to supply the castings used in the manufacturing plant of their own company. Frequently the manufacturing foundry has a capacity larger than is necessary to take care of the maximum needs of the plant with which it is connected. Jobbing work is then undertaken to utilize, as far as possible, the excess equipment above the needs of the manufacturing plant. If a reduction in plant activity occurs, the manufacturing foundry bids along with jobbing foundries for the orders of other industries. Both types of foundry, normally, do some jobbing work, but the exclusively jobbing concern must undertake a wide variety of special work, often booking most of its orders for immediate delivery. Obviously the foundry connected with a manufacturing plant has some advantage in that part of its product is in some measure standardized. Yet there is no sharp line of demarcation between jobbing foundries and those producing primarily for the consumption of their own plant.

Do manufacturing foundries operate more regularly than jobbing foundries or are they both subject to the same ups and downs? Actually, in the period of this study, there is little difference in stability in the two types of organization.

This conclusion may be readily checked by comparing the relative curves in Chart II. These curves, based on the average monthly production in 1926, represent 19 jobbing and 14 manufacturing foundries. There is a larger proportion of small capacity foundries in the jobbing than in the manufacturing group. An analysis of the total production of the 33 foundries shows that two-thirds of the tonnage is

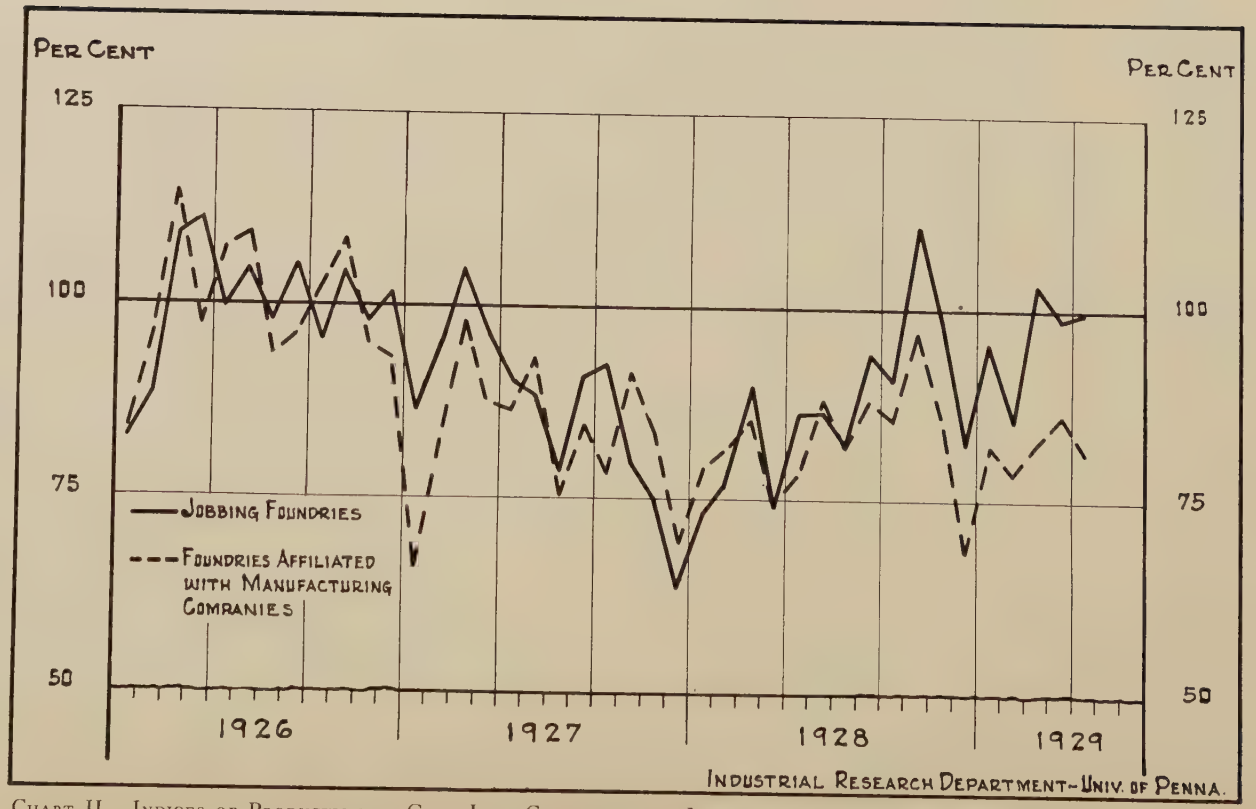

CHART II. INDICES OF PRODUCTION OF GRAY IRON CASTINGS IN 19 JOBBING AND 14 MANUFACTURING FOUNDRIES, 1926–1929
BASE-AVERAGE OF 1926

jobbing and only one-third intended for further manufacture within the plants.

Throughout 1926 and 1927 the curves are remarkably close, crossing and recrossing each other at intervals. In 1928 there appears to be a decided slowing down in the rate of the manufacturing group. The widening of the area between the two curves which started in April 1928 became especially marked in March 1929. Since the same tendency is evident, in this period, in the curves of large and small foundries, it is possible that the explanation is connected with the type of product rather than with either size or organization. At any rate, our analysis does not indicate that the foundries connected with manufacturing plants as a group have any advantage over the jobbing foundries in stability of production.

The Production of Large and Small Foundries

The nature of foundry work makes it an industry of small scale units. This is especially true of iron foundries. A few firms in the gray iron group produce less than 500 net tons a year; others produce more than 6,000 tons, though the largest yearly output reported was less than 7,000 tons.

The frequency grouping according to the annual production shows that one-half the foundries produced 1,750 tons or less in 1926 and that one-third of the foundries were above 3,200 tons. (Table 1)

With this variation in mind, it has been necessary to make some division according to size. Perhaps too arbitrarily, we have called foundries with a monthly capacity of 175 tons or less small and those above 175 tons large. This classification is based somewhat upon opinion and literature in the industry. Rawlinson[2] describes a small foundry as one in which the average tonnage produced would be from 10 to 40 net tons of iron castings per week. In our classification of firms, capacity rather than actual production was used as an indication of size.

[2] Rawlinson, William, *Modern Foundry Operations and Equipment*, London, 1928, p. 5.

TABLE 1

FREQUENCY DISTRIBUTION OF ANNUAL PRODUCTION OF GRAY IRON IN 33 FOUNDRIES CLASSIFIED BY ORGANIZATION AND LOCATION

Thousand Pounds	Number of Foundries								
	Total			Jobbing			Manufacturing		
	1926	1927	1928	1926	1927	1928	1926	1927	1928
Under 1000	5	5	6	2	2	3	3	3	3
1000 and under 2000	5	6	6	4	5	4	1	1	2
2000 and under 3000	4	6	6	3	3	4	1	3	2
3000 and under 4000	5	1	3	3	....	1	2	1	2
4000 and under 5000	1	5	1	....	3	....	1	2	1
5000 and under 6000	3	1	3	2	1	2	1	....	1
6000 and under 7000	2	2	....	....	1	....	2	1	....
7000 and under 8000	....	3	2	....	2	1	....	1	1
8000 and under 9000	2	1	2	2	1	2	....	....	....
9000 and under 10,000	1	1	1	....	....	1	1	1	....
10,000 and over	5	2	3	3	1	1	2	1	2
Total	33	33	33	19	19	19	14	14	14
Median	3500	2857	2714	3250	2750	2600	4000	3000	3000

Thousand Pounds	Number of Foundries					
	In Philadelphia			Outside Philadelphia		
	1926	1927	1928	1926	1927	1928
Under 1000	2	2	2	3	3	4
1000 and under 2000	1	1	1	4	5	5
2000 and under 3000	2	3	3	2	3	3
3000 and under 4000	2	1	1	3	....	2
4000 and under 5000	1	2	1	....	3	....
5000 and under 6000	2	1	2	1	....	1
6000 and under 7000	1	1	....	1	1	....
7000 and under 8000	....	2	1	....	1	1
8000 and under 9000	1	....	1	1	1	1
9000 and under 10,000	....	....	1	1	1	....
10,000 and over	3	2	2	2	....	1
Total	15	15	15	18	18	18
Median	4500	4333	4500	3000	2370	2000

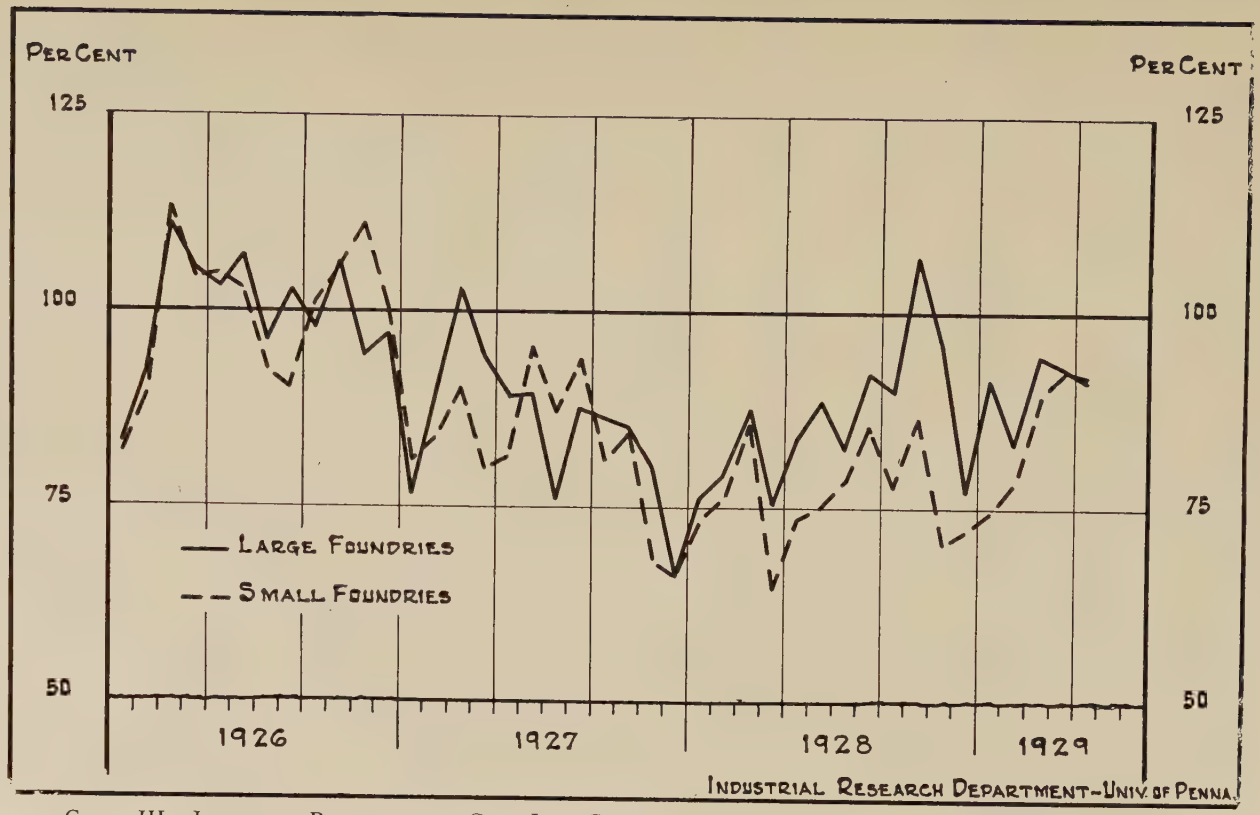

CHART III. INDICES OF PRODUCTION OF GRAY IRON CASTINGS IN 21 LARGE AND 12 SMALL FOUNDRIES, 1926–1929
BASE-AVERAGE OF 1926

The use of 175 tons as the distinction between large and small foundries did not result in an equal distribution, since 21 firms in the co-operating group had a capacity of 175 tons or over in 1926, leaving only 12 in the small group. The tendency since 1926 has been to increase the capacity of small units and two of the small foundries now produce more than 175 tons. In a few years it may be necessary to select a higher dividing line in order to determine relatively small foundries because foundries of less than 175 tons seem to be passing.

The curves of Chart III are based on the capacity rank in 1926. A comparison of the curves shows more difference in direction of movement than was noted in the case of jobbing and manufacturing firms. The curves frequently move in opposite directions.

Since 1926 is the base year, the space between the two curves must approximately balance; but even in that year the direction of movement differed both in August and November. By January 1928, the small foundries definitely began to fall below the large ones. The tendency started in the last quarter of 1927, but the decrease was too slight to be definite. If 1927 is considered, it will be evident that the recent trend is a decided contrast. In 1927, the index of small foundries exceeded the large ones in January, June, July, and August and the two almost coincided in October and December.

In 1928 the small foundries failed to come back from the depression of December 1927. The peak production in March was followed by a decline in April that was more severe than that of December 1927. The recovery after this second recession was extremely slow. August almost equalled March, and October slightly exceeded both. The large foundries, on the other hand, suffered only a slight decline in April, followed by a steady growth until October, which was surpassed only by March and June 1926.

By comparing the annual production of the two groups, the situation of the small foundries is made more noticeable.

	Small	*Large*
1926	100.0	100.0
1927	83.0	85.6
1928	76.8	86.5

In the dull year of 1927 the small foundries were 17 per cent and the large 14.4 per cent below their 1926 output. In 1928 the small group dropped 24.2 per cent below 1926 in a year when the large units showed a slight recovery. It is evident that the gap between the two widened materially.

It was shown in the discussion of manufacturing and jobbing foundries that for the past 21 months the foundries connected with manufacturing plants have not increased relatively as much as the jobbing concerns. Chart III indicates that there has been a decline in the business of small foundries. Yet there were more small foundries in the jobbing than in the manufacturing group. Can the two findings be reconciled? The answer is found in further analysis of the data. The small foundries connected with manufacturing plants, especially those in out-of-town areas, have steadily decreased in the past two years. They made no recovery after the dull period in 1927. Does this mean that small foundries connected with manufacturing have not the facilities for seeking new business when the activity of their own plant is curtailed? Or does it mean that they are equipped only for a special type of business? This raises the question of the size of foundry that it is profitable to maintain in affiliation with a plant, yet dependent at times upon outside orders. We do not attempt an answer. Yet, at a time of rapid change in foundry equipment, it is significant that large manufacturing foundries and jobbing concerns have secured all of the increase in business while the small manufacturing foundries have declined. One must conclude that the maintenance of volume in this class of plant depends either upon the acceptance of mechanization to perform a more general type of work or upon an improvement in the method of booking new orders.

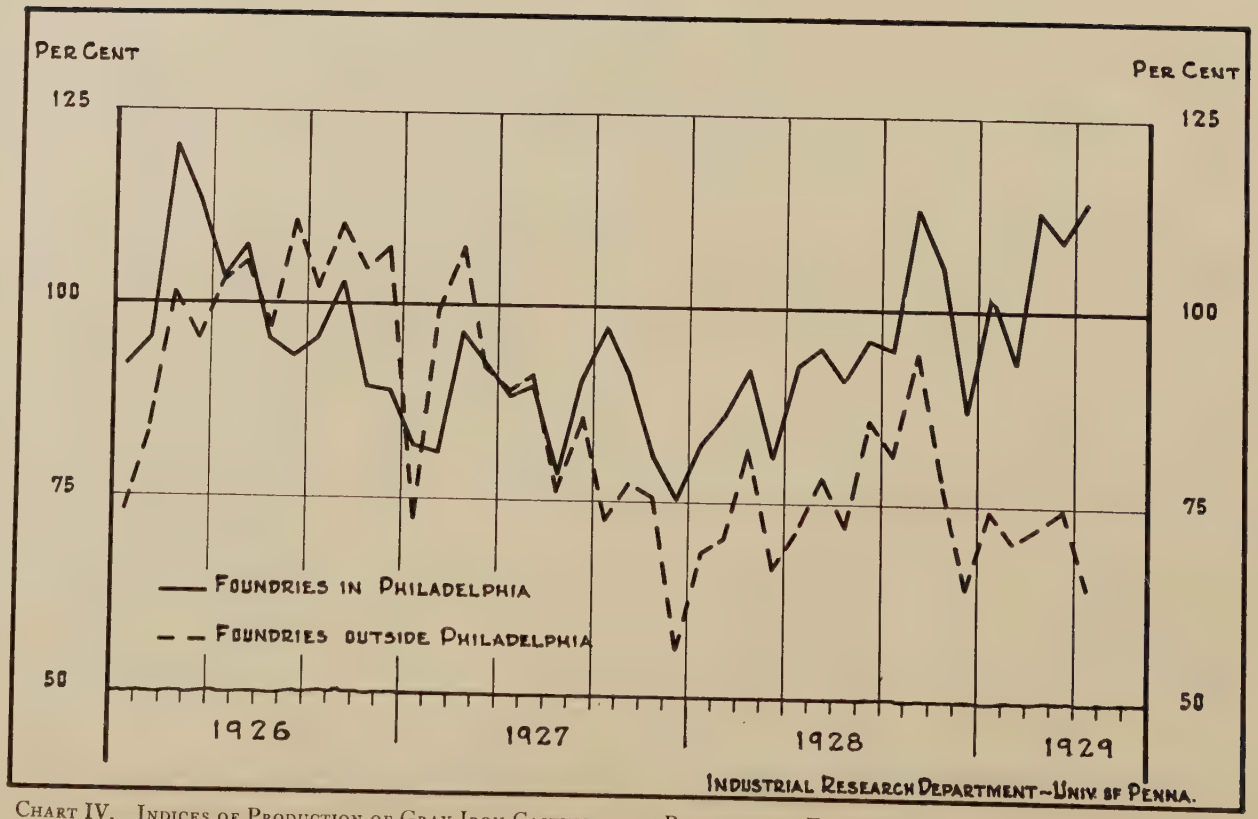

CHART IV. INDICES OF PRODUCTION OF GRAY IRON CASTINGS IN 15 PHILADELPHIA FOUNDRIES AND 18 OUT-OF-TOWN FOUNDRIES, 1926–1929
BASE-AVERAGE OF 1926

The Production of City and Out-of-Town Foundries

It has already been shown that small manufacturing foundries have been unable to compete equally with jobbing foundries in the past two years. An opinion of foundrymen, frequently stated to us in the course of this study, seems to be without statistical support. It is the inference that out-of-town foundries with lower rentals and labor costs can compete for business on a basis on which the city foundry cannot. We have attempted to test this statement by classifying foundries on the basis of location. Of the 33 firms producing gray iron exclusively, 15 were in Philadelphia and 18 scattered throughout the rest of the Third Federal Reserve District. Indices of production were computed with the average of 1926 as a base. The results are shown on Chart IV.

From July 1927 to date the Philadelphia firms have been consistently above the others. This does not necessarily mean that the foundries in Philadelphia are better off, but at least they have maintained a greater volume of production. The slack period of production at the close of 1927 was not so severe in Philadelphia as in the rest of the district.

The variation between the two curves can hardly be traced to differences in the composition of the groups. The samples are very similar in respect to size of foundries as shown by capacity and in respect to product as shown by purpose. About 40 per cent of the out-of-town foundries and 30 per

Distribution of Gray Iron Foundries According to Size and Location

	Number of Foundries	
	In Philadelphia	*Outside of Philadelphia*
Large.....	10	11
Small.....	5	7

cent of the Philadelphia firms rank as small foundries. A trifle over two-thirds of the tonnage of both groups is jobbing work.

The disparity between the curves of city foundries and out-of-town foundries is greater than was noted in the comparisons of size and organization. There is no evidence that

TABLE 2

PROPORTION OF JOBBING AND MANUFACTURING BY 33 GRAY IRON FOUNDRIES

Castings for	In Philadelphia			Outside Philadelphia		
	1926	1927	1928	1926	1927	1928
Jobbing	67.0	66.8	68.7	69.0	72.1	70.3
Further manufacture within the plant	33.0	33.2	31.3	31.0	27.9	29.7
Total	100.0	100.0	100.0	100.0	100.0	100.0

out-of-town foundries are operating more regularly or getting a proportionate share of the increase in castings work in 1928 and 1929.

Comparison of Gray Iron Production with Pig Iron Production.

The trend in gray iron output may now be considered more generally. For this purpose a longer series is essential and the production index has been computed from March 1924.

The Philadelphia Federal Reserve Bank started to collect foundry data in March 1924. More firms were added in April 1925. In enlarging the reporting group, the Research Department had to add firms whose records started in 1926.

Since most of the charts are of index numbers, it is possible to show the trend of production prior to 1926 by splicing the two series. The index was extended back to March 1924 by computing a chain index of production with the following month as a base, December on January, November on December, etc., and using for January 1926 only the firms whose records were complete from March 1924 to date. The results were converted to the same basis as the other indices by multiplying the index of January 1926 for 33 firms by the chain index number of December 1925 for the 1924 firms. This result, the index for December 1925, was multiplied by the chain index for November 1925 to derive the November index number on a fixed base. This process was continued for the rest of the period.

The resulting index of gray iron production is shown on Chart V along with the index of pig iron production in

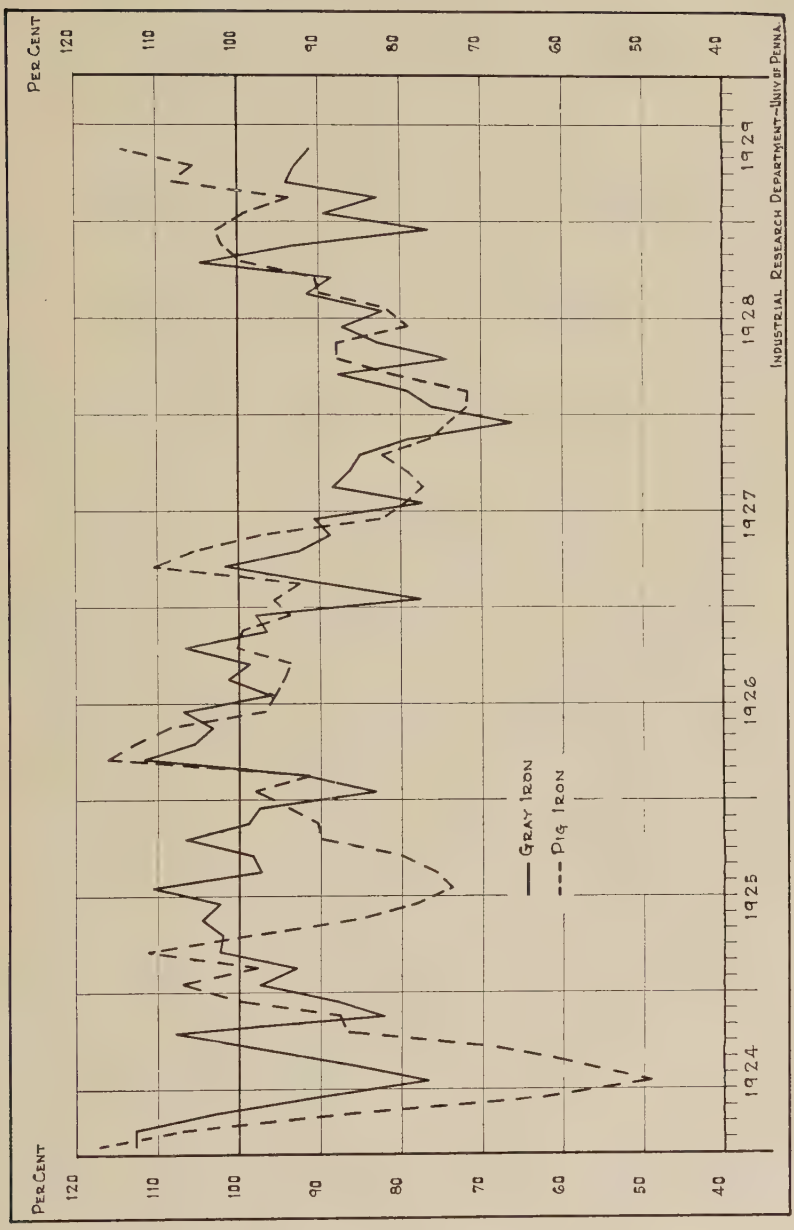

CHART V. INDICES OF PRODUCTION OF GRAY IRON CASTINGS IN 33 FOUNDRIES IN THE PHILADELPHIA FEDERAL RESERVE DISTRICT AND OF PIG IRON IN EASTERN PENNSYLVANIA, 1924–1929
BASE-AVERAGE OF 1926

eastern Pennsylvania. Pig iron has been chosen for this comparison instead of foundry iron because of the high percentage of scrap and alloys melted in addition to foundry iron.

The figures of pig iron production were obtained from the *Iron Age* by combining the tonnage for the Lehigh Valley, the Schuylkill Valley, the Lower Susquehanna Valley and western Pennsylvania. The latter does not include the Pittsburgh area.

It is evident from Chart V that pig iron output is subject to more extreme fluctuations than foundry output. Disregarding these extremes, and giving attention to the direction of movement, foundry production seems to be more sensitive in changes than the pig iron curve. From 1926 the pig iron curve tends to lag one or two months behind the foundry curve. It is not surprising that the two curves are sensitive to business changes. Both furnish a basic product of diverse uses. However, the comparison of the curves has a still wider significance. In the first place the ratio of foundry pig iron to total pig iron has been steadily decreasing. This may be offset by the additional use of scrap and alloys, or it may be that pressed metal and weldings are making inroads into the market for castings. The increased use of forged and stamped products cannot be overlooked. Their effect might be better gauged over a long period, but in the short interval of this study, gray iron production seems to be keeping pace with total pig iron output.

There are many reasons for thinking that foundry production should be a more sensitive indicator of business changes than pig iron production. To be sure, the process does follow pig iron in order of manufacturing. However, foundry orders are produced soon after they are received; hence foundry output responds quickly to a change in demand. On the other hand, the production of pig iron can only be changed by opening up or closing down a blast furnace. The expense of closing tends to prolong production after a decline in demand. Besides, pig iron can be stored and the production of blast furnaces need not react at the moment that orders

TABLE 3

INDICES OF THE PRODUCTION OF GRAY IRON CASTINGS IN 33 FOUNDRIES IN THE PHILADELPHIA FEDERAL RESERVE DISTRICT AND PIG IRON IN EASTERN PENNSYLVANIA 1924–1929

(Base-Average 1926)

Month	1924		1925		1926		1927		1928		1929	
	Gray Iron	Pig Iron	Gray Iron	Pig Iron	Gray Iron	Pig Iron	Gray Iron	Pig Iron	Gray Iron	Pig Iron	Gray Iron	Pig Iron
January	.....	105.7	97.2	106.9	83.3	98.0	77.6	95.6	76.3	71.8	89.6	99.5
February	.....	107.3	93.0	97.7	92.0	91.4	89.8	92.5	79.2	71.8	83.0	93.8
March	112.7	117.3	102.4	111.0	111.6	116.0	101.7	110.4	87.7	80.8	94.1	108.1
April	112.7	106.5	102.0	98.5	105.3	112.6	92.6	105.5	74.3	87.8	93.2	105.5
May	102.8	87.0	104.5	85.7	103.4	108.2	88.9	97.3	82.9	87.9	91.4	114.4
June	89.7	62.6	102.3	78.2	106.9	96.7	90.6	82.5	87.3	79.0		
July	76.6	49.2	110.6	73.7	96.2	95.5	77.4	79.5	82.2	81.8		
August	86.2	57.7	97.4	75.8	101.5	94.4	88.4	77.1	91.5	90.0		
September	98.1	68.4	98.4	80.0	98.7	93.7	86.2	79.2	88.6	90.6		
October	107.9	86.7	106.5	89.9	106.6	100.2	85.1	82.3	104.6	99.8		
November	82.1	87.5	98.8	90.2	96.6	99.6	78.9	76.3	93.2	102.0		
December	88.3	100.1	97.6	94.0	97.9	93.6	66.3	74.0	76.6	102.7		

improve. The foundry product is a custom-made product. It is not produced for stock. Foundry production depends directly upon the requirements of other industries. Consequently the output responds quickly to any change in other industries.

The extreme fluctuation of the pig iron curve which results from opening or closing whole units at a time could not occur in foundry production.

SHIPMENTS OF GRAY IRON CASTINGS

The firms included in this study are reporting their shipments both by weight and value. Since all the products of jobbing foundries are made for shipment, and the manufacturing foundries charge the deliveries to their plant as shipments, there cannot be much variation between the tonnage of good castings produced and the tonnage shipped. The comparison of shipments and production serves mainly to check the accuracy of the reporting.

Chart VI shows how close is the correspondence between the tonnage produced and shipped in gray iron foundries. This is to be expected because few foundries manufacture for stock.

It should be admitted that the method of reporting also

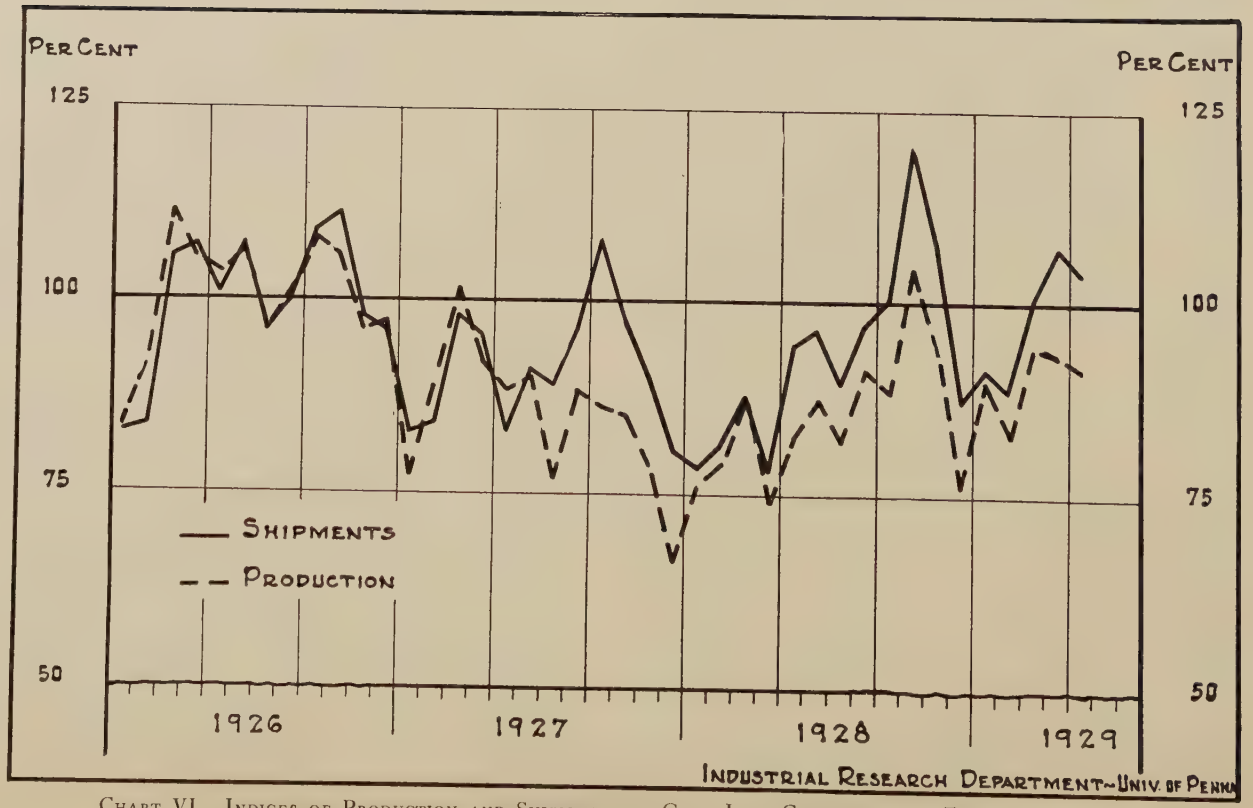

CHART VI. INDICES OF PRODUCTION AND SHIPMENTS OF GRAY IRON CASTINGS IN 33 FOUNDRIES, 1926-1929
BASE-AVERAGE OF 1926

adds to the normal similarity in the items. Several foundries keep only a record of the volume of their shipments and the same figure has to be used as sufficiently indicating production. The correspondence between the production and shipment curves of other foundries justifies this practice. Throughout the industry shipments are made almost immediately. Probably one of the most extreme cases is that of one concern which boasts that its castings are delivered the day after pouring.

The real interest of the figures of shipments centers about the relation between tonnage and value. Any disparity between the two curves indicates a change in the price of castings.

Since the year of good business in 1926, foundrymen have complained of the gradual trend toward lower prices for castings. Along with the decline in the price of castings, many orders were placed in small lots for immediate delivery. The curves of Chart VII reflect this tendency. The increase in business since 1928 has come about only through a considerable lowering of prices. This reduction in value was especially drastic in the summer months of 1928. Prices improved slightly in the increase of production in October, but the spring months of 1929 show a discrepancy between value and tonnage almost as wide as that which occurred in the dull summer months of 1928. Chart VII indicates clearly that, by contrast with 1926, the value of castings has decreased despite a fairly high rate of operation.

No one outside the industry could say whether the decrease in the relative value of castings means that foundries are working to closer profit margins or not. Students of iron founding note a tendency toward increased production per unit of man power. Marked changes have come recently in molding machinery, in handling equipment and in foundry methods generally. These changes, along with the lowered price of pig iron, have doubtless tended to reduce the cost of gray iron founding. The extent to which these factors explain the decrease in value is uncertain.

Besides, there is a great variation in the classes of castings

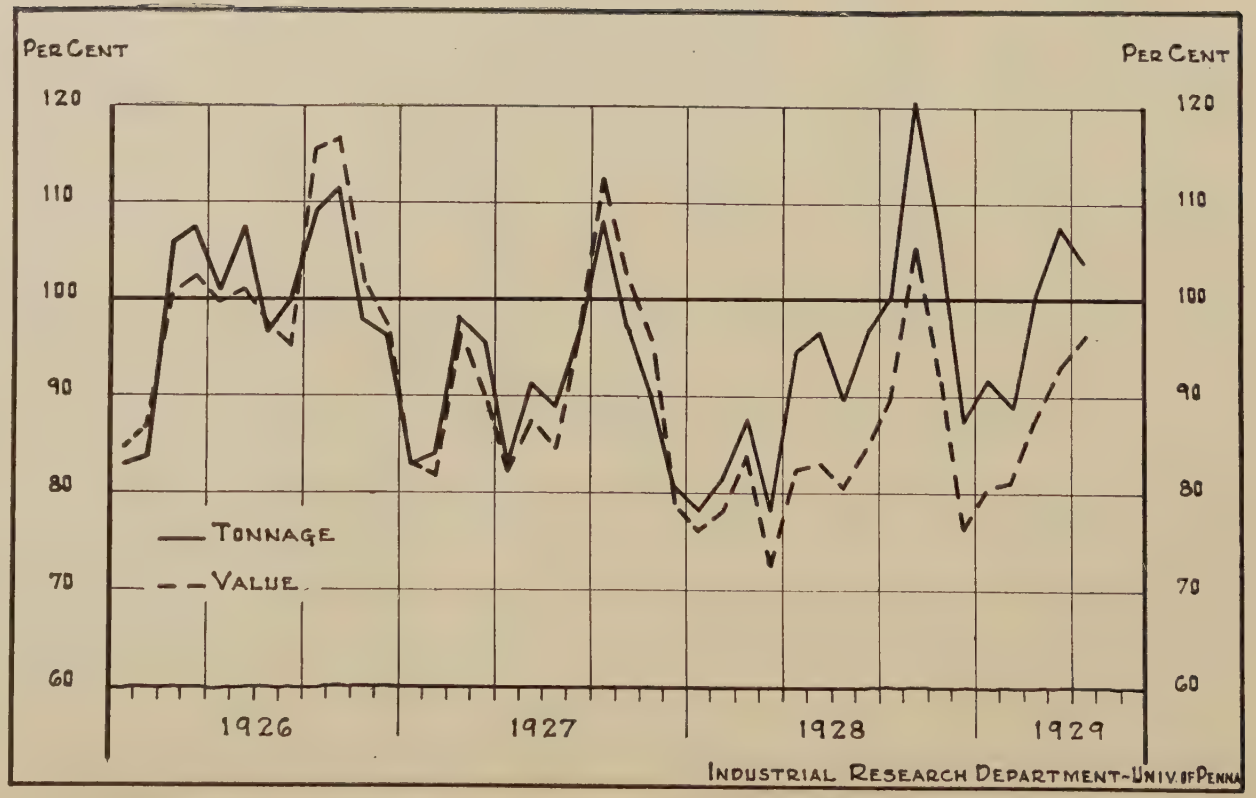

CHART VII. INDICES OF TONNAGE AND VALUE OF SHIPMENTS OF GRAY IRON CASTINGS IN 33 FOUNDRIES, 1926 1929
BASE-AVERAGE OF 1926

produced by any one firm, or by a group of firms, in different seasons. If a foundry is engaged on small work, the value of its shipments will increase at the same time that tonnage is decreasing. A shift to the manufacture of a higher proportion of heavy castings might increase tonnage without a corresponding increase in value, but such a change in demand would be unlikely to affect a large group of foundries for a period of 16 months.

The curve of the value of shipments raises some interesting questions. Have foundries been filling back orders contracted for in the dull months of 1927? Has there been a change in the class of castings? Have economies in the industry made possible a normal reduction to the consumers of foundry products, or have the years 1928 and 1929 been marked by keen competition and price-cutting? The matter deserves the attention of foundrymen.

The curves of the value and tonnage of shipments have other signs of interest in periods of rapid change. In periods of recession in production, prices usually drop relatively more than output. The opposite tendency is manifest in peaks of activity. This is in line with the comment in the industry that in slack periods much work is undertaken if it will bear even part of the cost of overhead.

There is little material available concerning the actual prices at which castings are sold. No other part of our monthly releases has brought as much comment as the *price per pound*. We have been forced to use the value of castings divided by the tonnage, which gives an average price per pound for all types of castings which happened to make up the month's total. Not only are small, heavy and specialized work represented without regard to variations in the proportions of each, but, if we make use of all firms in the group, a small amount of malleable and non-ferrous castings has to be included in the monthly figure. Obviously, such an average will not tally with the price received by a foundry making a special type of castings. It is change in the average price per pound, not the exact amount, that is of interest here.

For this study the price figures have been revised to include

the foundries which make gray iron exclusively. This revision shows a downward trend in the average price per pound. Strangely enough, the downward trend was less marked in 1927 than it has been in the period since 1928. The average price of castings shipped in 1926 was 6.3 cents by comparison with 5.6 cents in 1928. The result of this lowering in price has been shown on Chart VII in the widening of the area between value and tonnage shipped. The difference in price per pound may seem small, but to the industry it meant $660,000 less in 1928 for a larger tonnage than was shipped in 1927, about 9 per cent of the total value. The average prices per pound in the 33 foundries are given in Table 4. They should be considered in the light of the fact that the figure is a composite for all kinds of castings.

TABLE 4

AVERAGE PRICE PER POUND OF SHIPMENTS OF GRAY IRON CASTINGS IN 33 FOUNDRIES

Month	1926	1927	1928	1929
January	.0645	.0631	.0614	.0555
February	.0654	.0614	.0603	.0579
March	.0599	.0622	.0603	.0549
April	.0602	.0595	.0585	.0549
May	.0625	.0623	.0549	.0584
June	.0595	.0605	.0542	
July	.0638	.0599	.0567	
August	.0601	.0632	.0552	
September	.0668	.0658	.0565	
October	.0660	.0666	.0550	
November	.0655	.0668	.0542	
December	.0638	.0618	.0551	

No more adequate price data can be given unless a classification of foundry products is possible. The industry is itself in need of such information. Too much of the price-setting in the industry is still based on weight. As late as August 1926, an article in *The Foundry* comments upon this practice even in selling steel castings. The author says:[3]

"There is not necessarily any relation whatsoever between the costs of two castings whose weights are identical. One may be chunky and

[3]Utley, S. W., "Are You Playing Fair with Your Stockholder?" *The Foundry*, August 1, 1926, p. 591.

compact; using simple cores or none at all, easy to mold and easy to clean, with little hazard as to loss and producing a large tonnage per square foot of floor space. The other, of equal weight, and therefore equal selling price, may be of thin section and rangy, taking much larger flasks than the first, requiring the setting of intricate cores, having a comparatively high molding and cleaning cost, subject to excessive cracking, liable to a high percentage of loss and yielding a comparatively low production per square foot of floor space. There is no reason under the sun for selling these two castings at the same schedule price, except the fact that the individual sellers in the industry as a whole have been too negligent to insist that they be paid in accordance with the worth of the casting, rather than by a rule of thumb."

This illustrates both the difficulty of determining prices and the need for more definite price data.

The Trend of Unfilled Orders

Unfilled orders have been reported both in tonnage and approximate value in dollars. The curves of the prices of shipments and unfilled orders, given in Chart VIII, present some difficulties. It is hard to find an explanation for the difference between the price of shipments and the price of unfilled orders during the last half of 1927 and again at the beginning of 1929. During the last half of 1927 and all of 1928 the two indices of price run very closely together. To be sure, unfilled orders are taken at the end of each month, whereas shipments occur at all times throughout the month.

The price of unfilled orders shows the same tendency evident in shipments to decrease from the end of 1927 to date. In 1929 the decrease in price is more extreme in unfilled orders than in shipments. If the present price of unfilled orders is not caused by a passing irregularity, it does not augur well for the prices of castings in the last half of 1929. Considering the unexplainable divergence of the two curves in 1927, which can hardly be attributed to orders booked in 1926, undue emphasis should not be given to the present movement.[4]

The tonnage of unfilled orders is an even more difficult

[4] In order to compare the prices of shipments and unfilled orders it has been necessary to reduce the actual prices to an index basis because, in several cases, prices of unfilled orders include the estimated cost of machining while in all cases the price of shipments represents only the foundry cost or cost of castings without machining.

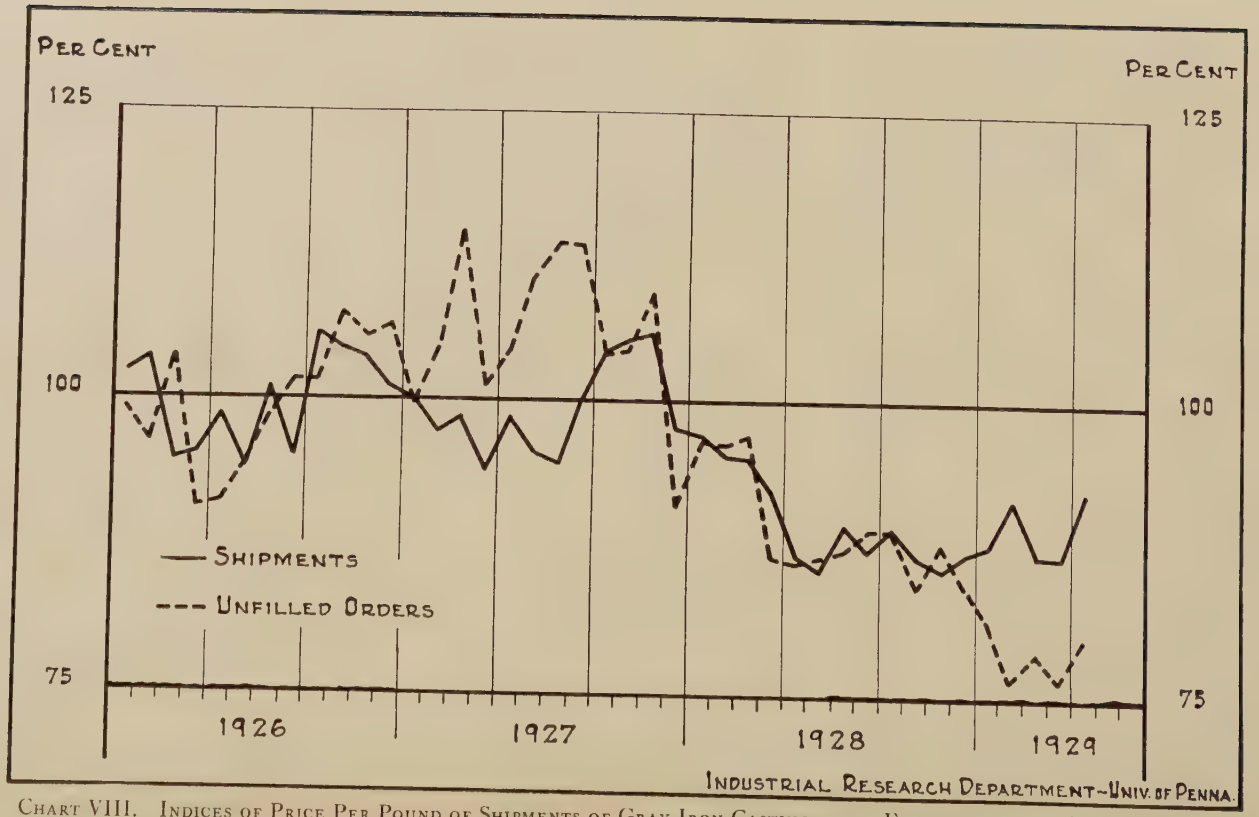

CHART VIII. INDICES OF PRICE PER POUND OF SHIPMENTS OF GRAY IRON CASTINGS IN 33 FOUNDRIES AND OF UNFILLED ORDERS FOR GRAY IRON CASTINGS IN 21 FOUNDRIES, 1926–1929
BASE-AVERAGE OF 1926

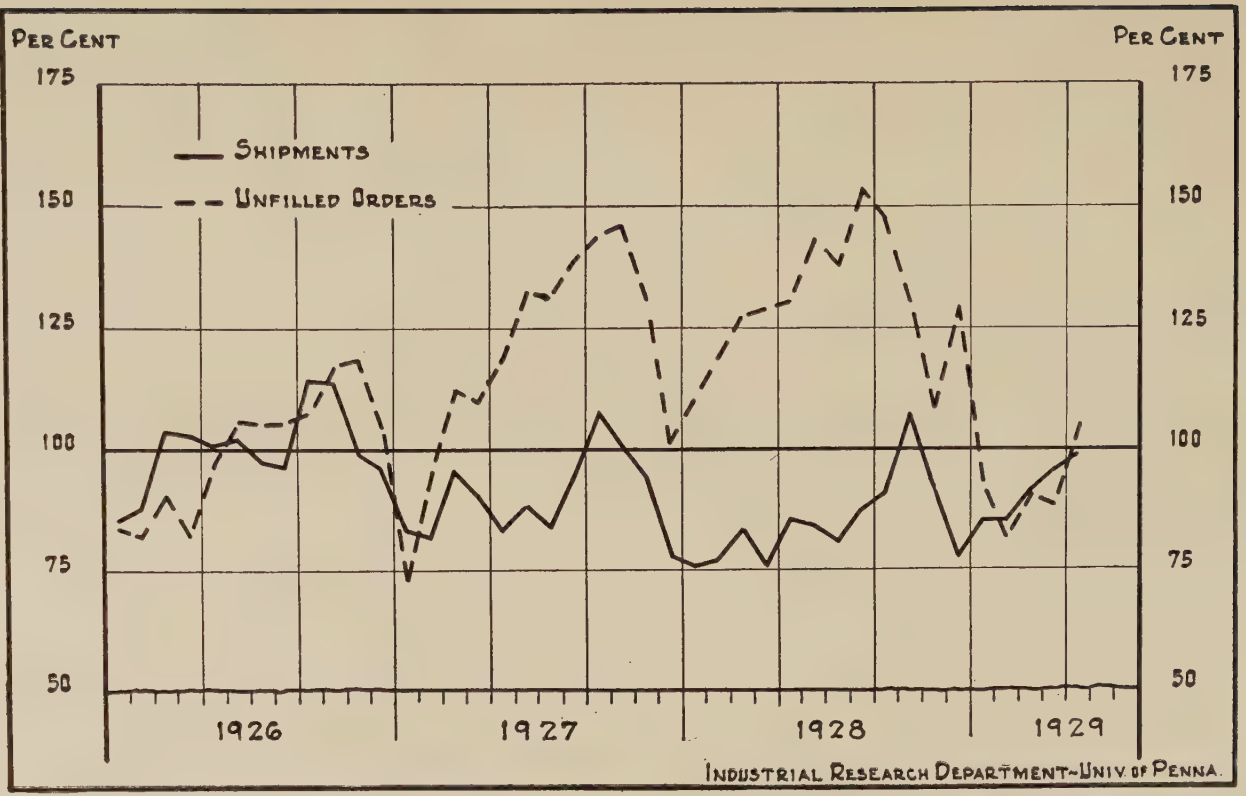

CHART IX. INDICES OF VALUE OF SHIPMENTS OF GRAY IRON CASTINGS IN 33 FOUNDRIES AND OF UNFILLED ORDERS FOR GRAY IRON CASTINGS IN 21 FOUNDRIES, 1926–1929
BASE-AVERAGE OF 1926

item to interpret than the price. We are convinced that the figures are reported with as much accuracy as is usual in data for unfilled orders. The fact that many orders are subject to cancellation and others are cleared from the books in December, accounts for the extreme dip in the curve at the end of each year. Some of the apparent sweep upward in orders in 1927 and 1928 may be due to the use of a single year as a base. It is too early to conclude that the figures would have no value to the industry if a record were available for a period long enough to compare with the unfilled orders of other industries. For the time being, it is necessary to confess that we have not yet been able to explain or demonstrate the worth of the figures in relation to future developments in the industry.

The Ratio of Production to Capacity

The Definition of Capacity

There is a tendency in most industries to confuse output, or the quantity produced ready for distribution in a given time, with capacity. Active power is often much easier to reckon than passive power. Foundry capacity has its own special difficulties.

The discussion of capacity has caused more disagreement among foundrymen than any other one problem. What is capacity? How shall it be determined? These two questions had to be answered before the ratio of production to capacity could be measured.

As a preliminary step, the time to be covered by the capacity figure had to be decided. There is no uniformity in practice so that daily, weekly, monthly, or yearly capacity could have been used. A monthly capacity figure was selected because reports were made on the basis of a calendar month. This has created another question since there are variations in the number of working days in different months. In order that changes in capacity should be caused only by expansion of plant facilities, a constant figure representing a mythical or standard average month's capacity was used. When an annual ratio of production to capacity was desired,

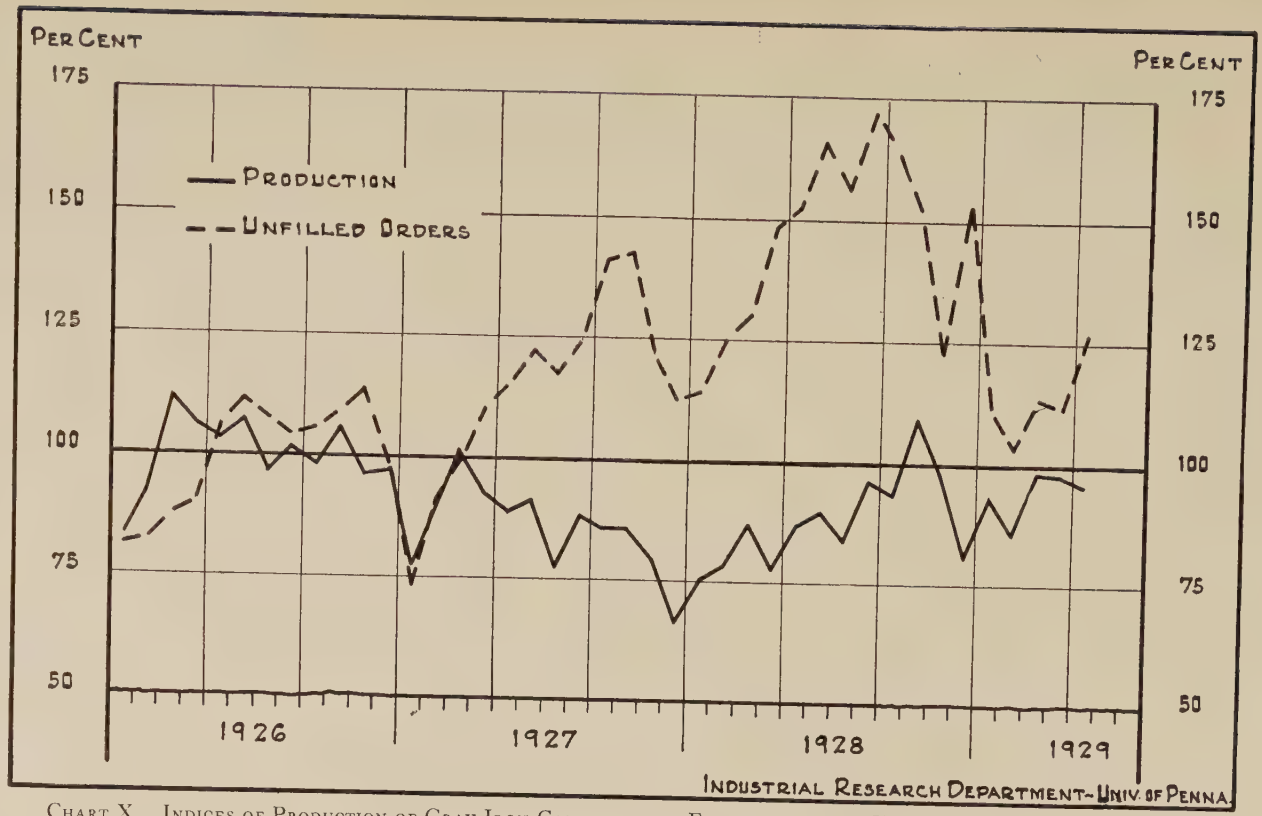

CHART X. INDICES OF PRODUCTION OF GRAY IRON CASTINGS IN 33 FOUNDRIES AND OF UNFILLED ORDERS FOR GRAY IRON CASTINGS IN 21 FOUNDRIES, 1926–1929
BASE-AVERAGE OF 1926

the monthly capacity multiplied by 12 was used after making allowance for any changes in equipment that may have been reported during the year.

The next step involved the choice of a unit in which capacity might be expressed. Should it be the amount of metal that could be melted, the tonnage of castings, the tonnage of good castings or should it be stated in terms of some unit other than tons? Should the molding floor space, the molding equipment or the number of molders be considered?

The amount of metal that could be melted would give the cupola capacity. But no foundry means to be limited by melting capacity. Even though in emergencies the cupola can be operated for more hours than the plant, it is usual to allow some excess melting power over and above normal requirements. It seems to be quite generally agreed that this is not an accurate measure because most foundries do not operate their cupolas continuously, since the molding floor could not use all of the metal that might be melted. In this area the common practice is to pour castings late in the afternoon and usually the molder does the pouring. Cupola capacity is also subject to a special group of variations. Rawlinson[5] states three factors which govern the rate at which metal can be melted: (1) the sectional area at the melting zone, over which combustion of the fuel takes place; (2) the amount of coke used; (3) the amount of air delivered. In other words, the method of operation must be considered even in cupola capacity. The increasing use of steel scrap and other alloys retards the melting so that the cupola must be operated for several hours more than formerly. Although the actual output may not be affected, the potential capacity of the plant has certainly been reduced. The final objection to the use of the cupola capacity comes from the purpose for which the capacity figure was intended—comparison between actual and possible production. From the inception of this study it has been agreed that only good castings should be reported. The production figures, therefore, do not include metal charged into the cupola or the amount of castings pro-

[5] *Op. cit.*, page 64.

duced, but rather the tonnage of good castings. The capacity figure, in order to be comparable with the production reports, must be in terms of good castings that can be produced. This requirement completely eliminates the use of cupola capacity alone in this study.

Other proposals for calculating capacity must make allowance for internal factors which may cause fluctuations in output. The hours per day, the days per week, the number of employees, the ability of the workers, the efficiency of the management, the type of castings being produced and the molding floor space affect the tonnage of castings which could be produced with the existing equipment.

In this district most foundries work nine hours per day, but employment is not steady or continuous. There is no uniform rule concerning Saturday work except that there are no Saturday afternoons off. Some plants plan to give alternating Saturdays to the employees.

The number of employees varies with the production and general activity of the foundry. The capacity of the plant is not changed if a full force of workers is not employed. Any measurement of potential production should include the maximum amount of labor that can be used. It must also assume that conditions within the plant are standardized so that the individual production of employees can be determined.

The only justifiable reasons for increasing or decreasing the capacity figure is a shift in product or a change in plant or equipment. If the type of castings is changed, it is probable that the total amount that could be made will be affected. The replacement of old equipment, or an addition to the plant, will increase the capacity of the foundry.

The effect of changes in product is stressed by many executives. One writes: "The monthly capacity can be only an approximate amount governed by our floor space but primarily governed by the sort of product manufactured. Some types of product, even if made exclusively, would raise the capacity 50 per cent, whereas, if we should specialize on some

of the lighter type of castings, the capacity would be reduced as much as 25 to 50 per cent."

The malleable iron concerns which report directly to the United States Department of Commerce compute their capacity on the basis of the following formula:

> The total number of units of molding floor space times the average production per molder per day per unit of floor space times the number of actual working days in the month.

There is some argument for the use of the actual number of working days in the month because holidays and short months do affect the actual production. In constructing a ratio, however, it is desirable to have as constant, or as nearly constant, a base as possible. If the base is constant, any variations in the ratio will be the result of fluctuations in only one factor and will be easier to understand.

The main criticism of this formula is that it is based, in part, upon the efficiency of the present employees. The fact that the average production per worker is reduced either by conditions within the plant or the inefficiency of new workmen does not seem to be a reason for reducing the capacity figure. This formula gives a lower figure than the judgment of foundrymen warrants. The superintendent of one plant estimated that his foundry could produce 25 per cent more than the result the formula showed.

After all, these objections are of minor importance compared with the advantage of a uniform practice throughout the industry. We should gladly have adopted this formula if it could be used in gray iron foundries. But it is not easy to define even a *unit of molding floor space* in an industry with as wide a variety of product as is found in gray iron foundries. Malleable castings are more specialized and are made under conditions more nearly standard than are found in gray iron foundries.

Several foundrymen have suggested that an average of the five best months since 1926, or a longer period, would give a satisfactory measure of capacity. This would give a figure which the foundry has actually attained in a busy period. In a new branch of the industry the figure would be adequate.

In an old industry, it would undoubtedly give a lower figure than would be obtained by most other methods, unless one could be certain that the five best months represented the average run of product with the plant operating at its maximum producing power.

Yet the principle seems to be erroneous. The difference between capacity and output seems to be overlooked. Capacity should be the maximum amount that could be produced with the existing equipment, in the present stage of the founding art. This assumes sufficient labor to operate the plant fully on the average run of work. If it appears that the equipment is only partially in use, it is better to be aware of the fact than to disguise it by considering past production as capacity.

For purposes of plant management it is proper to base budgets and other plans on estimates of the future with regard to the past. Yet even here the sales division should not forget that the plant may be able to produce more than was planned. When the problem of capacity is viewed from the standpoint of the industry as a whole rather than from that of an individual foundry, it is even more important that capacity should represent the maximum potential production.

Probably in use these objections would not be very important if we had not the emergency capacity of the war to absorb. But some foundries report that they have not had a chance to use their molding space fully since 1920.

After much discussion and checking, we were forced to use an unstandardized measure of capacity.

The figures for capacity which have been used in this study were secured from the reporting firms by letters and interviews. The question asked was, "What, in your opinion, is the maximum amount of good castings which your foundry could produce in normal working time for a month with an average run of work such as your shop produces?"

The results are thus based upon estimates of practical foundrymen rather than upon a standard formula. Allowance has been made for changes in product, plant or equip-

ment, but the other factors, such as labor and working conditions, have remained constant. The superintendents of foundries have tried to consider a "fair average" of the year. Tonnage of good castings rather than melt or total production has been chosen as the unit of measurement. Thus production, as reported monthly by the firms, is comparable to the capacity estimate in that both are based on good castings.

This measure of capacity should show the producing power in the full-time scheduled working hours of the plant. Operation above this capacity could easily result, if over-time or extra shifts were worked.

How does the actual production compare with the measure of capacity arrived at in this way? The ratio of production to capacity in 1926 was 50.1; in 1927 it was 42.2, and in 1928, 42.0. The ratio of 1928 did not increase, though production did because a few foundries expanded.

The average of all firms does not reflect the differences in the industry. A tabulation of the ratio of production in individual firms for the three years covered by the study causes surprise at the wide variations in operating conditions. Even in 1926, 18 per cent of the reporting firms were operating at less than 25 per cent of capacity. The proportion in this group was 33 per cent in 1928. The table shows that only a few plants in each year operate above 75 per cent of capacity.

TABLE 5

RATIO OF PRODUCTION TO CAPACITY IN GRAY IRON FOUNDRIES

	1926		1927		1928	
	Number of Firms	Per Cent of Total	Number of Firms	Per Cent of Total	Number of Firms	Per Cent of Total
Under 25 per cent of capacity	6	18.2	9	27.3	11	33.3
25 per cent and under 50 per cent	8	24.2	11	33.3	8	24.2
50 per cent and under 75 per cent	12	36.4	9	27.3	13	39.4
75 per cent and over	7	21.2	4	12.1	1	3.1
Total	33		33		33	

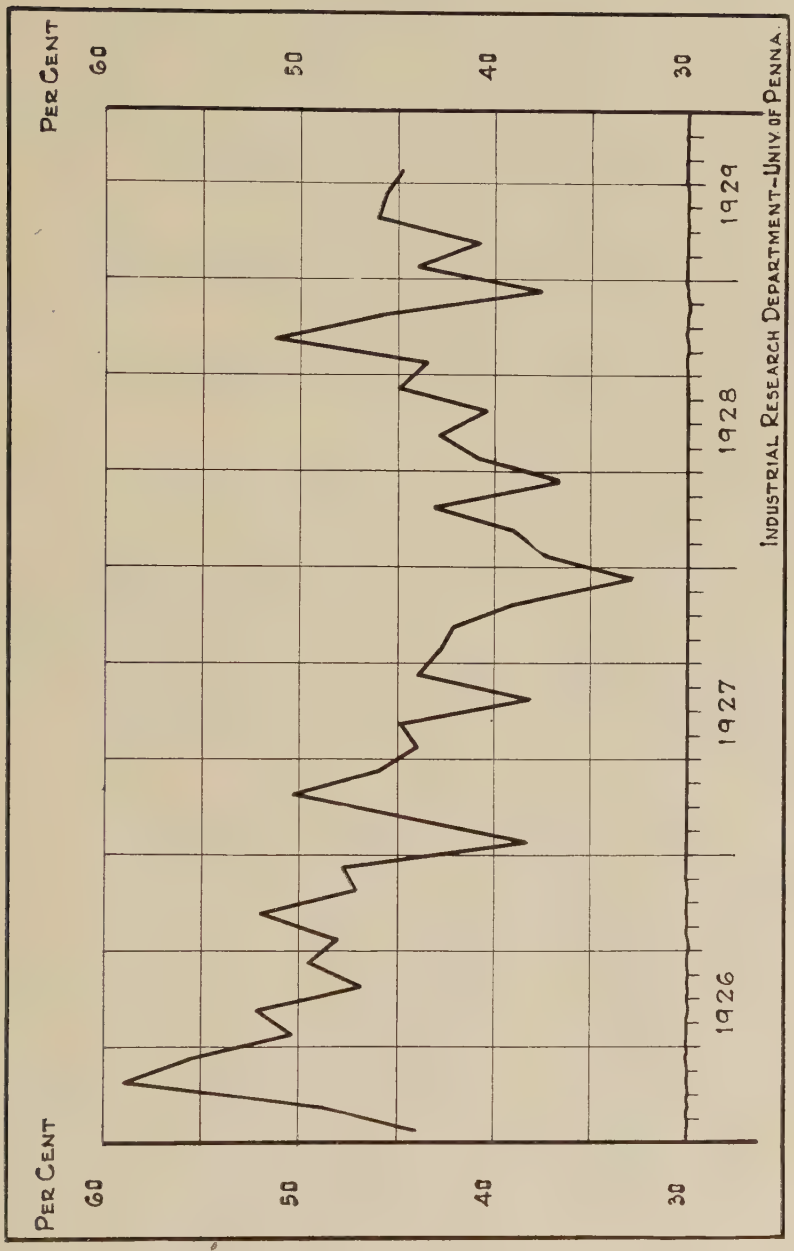

CHART XI. RATIO OF PRODUCTION TO CAPACITY IN 33 GRAY IRON FOUNDRIES

Only two firms reported operations at 100 per cent of capacity in 1926. One of these maintained its record in the following years; the other dropped to 42 per cent in 1927 and reached only 19 per cent in 1928. These figures show the variations in the same foundry at different periods. Some concerns did not share in the activity of 1926; three have been below 20 per cent of their own estimate of productive power in each of the last three years. This illustrates the fact that two quite different groups are represented: the one able to operate fully in busy periods, the other unable to use its present equipment fully at any time. The result is that the ratio of production of several firms does not follow the general trend of the industry.

The trend of the ratio of production to capacity was downward from March 1926 to December 1927. In the peak of 1926 our ratio was 59.0. For the same month of the following years, the ratio was 50.3 in 1927 and 43.1 and 46.2 in 1928 and 1929 respectively. This would indicate about 40 per cent of idle equipment in 1926. Granting that this should be reduced somewhat to allow for seasonality and special plant conditions, it would be conservative to claim 25 per cent of unused capacity in the busiest period of recent years.

TABLE 6

RATIO OF PRODUCTION TO CAPACITY IN 33 GRAY IRON FOUNDRIES

Month	1926	1927	1928	1929
January	44.0	38.4	37.5	44.0
February	48.7	44.5	38.9	40.7
March	59.0	50.3	43.1	46.1
April	55.7	45.9	36.5	45.8
May	50.4	44.0	40.7	44.9
June	52.1	44.8	42.9	
July	46.9	38.3	40.4	
August	49.5	43.8	45.0	
September	48.2	42.7	43.5	
October	52.0	42.1	51.4	
November	47.1	39.0	45.8	
December	47.8	32.8	37.6	

The differences among the foundries show the advisability of further separation in order to determine what foundries

are doing. The chart is summarized in the frequency tables. Median ratios rather than average have been selected because the median is less influenced by extreme items. It should be noted that for all foundries there is little difference between the average and the median.

TABLE 7

RATIO OF PRODUCTION TO CAPACITY IN LARGE AND SMALL GRAY IRON FOUNDRIES

Per Cent	Number of Foundries								
	Total			Large Foundries			Small Foundries		
	1926	1927	1928	1926	1927	1928	1926	1927	1928
Under 10	.....	1	1	.....	.....	.....	.....	1	1
10 and under 20	3	3	7	1	2	5	2	1	2
20 and under 30	5	6	4	5	4	2	.....	2	2
30 and under 40	4	3	4	1	1	2	3	2	2
40 and under 50	2	7	3	2	4	2	.....	3	1
50 and under 60	8	5	5	4	4	3	4	1	2
60 and under 70	.....	4	7	.....	4	5	.....	.....	2
70 and under 80	7	1	1	5	.....	1	2	1	.....
80 and under 90	1	1	.....	1	.....	.....	.....	1	.....
90 and over	3	2	1	2	2	1	1	.....	.....
Total	33	33	33	21	21	21	12	12	12
Median	53.3	45.0	42.5	54.0	48.0	46.7	53.0	40.0	35.0

Here, as elsewhere in the study, we have made comparisons between groups of firms divided on different bases. In 1926 the large and small foundries were operating at practically the same percentage of capacity. In 1927 the median for the small foundries had decreased considerably more than that for large foundries. This tendency is further shown in 1928 when the median for small foundries was 35 per cent as compared with 46.7 per cent for the median of large foundries.

When the firms are divided on the basis of location, that is, those in Philadelphia compared with those outside of Philadelphia but within the Philadelphia Federal Reserve District, the difference is more striking than that shown by differences in size.

The Philadelphia firms have maintained a fairly consistent ratio, although there was a decrease in 1927. The other

TABLE 8

RATIO OF PRODUCTION TO CAPACITY IN GRAY IRON FOUNDRIES CLASSIFIED BY LOCATION AND ORGANIZATION

Per Cent	Number of Foundries											
	In Philadelphia			Outside Philadelphia			Jobbing			Manufacturing		
	1926	1927	1928	1926	1927	1928	1926	1927	1928	1926	1927	1928
Under 10	....	....	....	....	1	1	....	1	1	....	....	....
10 and under 20	....	1	1	3	2	6	1	1	2	2	2	5
20 and under 30	3	3	3	2	3	1	3	2	2	2	4	2
30 and under 40	1	....	1	3	3	3	2	3	3	2	....	1
40 and under 50	....	4	....	2	3	3	1	4	3	1	3	....
50 and under 60	5	2	4	3	3	1	5	3	3	3	2	2
60 and under 70	....	3	4	....	1	3	....	2	3	....	2	4
70 and under 80	5	....	1	2	1	....	4	1	1	3	....	....
80 and under 90	....	1	....	1	....	....	1	....	....	....	1	....
90 and over	1	1	1	2	1	....	2	2	1	1	....	....
Total	15	15	15	18	18	18	19	19	19	14	14	14
Median	56.7	48.0	56.0	45.0	40.0	33.8	55.0	46.0	45.0	50.0	43.8	30.0

foundries, which in 1926 were considerably below the Philadelphia firms, have since fallen off, until in 1928 they operated on a 33.8 percentage of capacity compared with 56 per cent for Philadelphia firms.

Jobbing foundries, which had a 55 per cent ratio in 1926, reported only 45 per cent in 1928. Foundries affiliated with manufacturing enterprises showed a sharper rate of decline—from 50 per cent in 1926 to 30 per cent in 1928.

In discussing at some length the question of excess capacity in the industry, we are not unmindful of the interest in the figure of ratio of production to capacity or of possible criticism of our method. We can only say that most plant executives would agree that the capacity figure used for their plant is conservative.

CAUSES OF OVER-EQUIPMENT

There are many explanations of the excess capacity noted in foundries. In *The Foundry* for March 1, 1920, there is this statement:[6]

[6] Editorial, p. 203.

"It is commonly understood that when a manufacturer places an order for a great number of castings upon which he can receive no assurance of time of delivery and little guarantee of price he duplicates his order with a number of foundries. Then when his requirements are covered by the delivery of his order from one firm, he at once will cancel the pending orders with other foundries. There is a basis for the opinion held by some foundrymen that the present demand is inflated and that the rapid expansion of foundry facilities may eventually result in a general slackening off with the item reaction comparable to over-production."

The editor thus foresaw the condition which exists to-day. We have no means of telling from our own records what the ratio of production to capacity was in 1920, but there is evidence at hand which shows that there was a tremendous expansion in plant and equipment during the war and post-war periods.

There is another reason to account for part of the excess equipment. Some jobbing foundries report that when a manufacturer places a large order with them covering several months to a year, he demands that enough equipment be kept ready at all times to fill his needs. Foundries may find themselves forced to turn away orders and thus reduce their production in order to provide for possible requisitions from the manufacturer.

One must also remember that the foundry industry is held together by a process rather than by similar product and that a firm which can profitably produce castings of one size or for another industry may find itself unable to handle different castings. This specialization of foundries has inevitably tended to the maintenance of some excess capacity. For example: a manufacturer of textile machinery may expand his facilities in order to take care of orders. Later, when the temporary demand has passed, he finds himself burdened with equipment for which he has little use. If, later, there is a demand for cast iron pipe or stoves, he cannot participate in that period of prosperity. In turn, the pipe foundries or stove foundries, in expanding their facilities, will not be able to secure added production when a later boom comes in automobile castings. This condition, repeating itself with the recurrent phases of the various cycles of business, has

undoubtedly contributed to the low ratio of actual to potential production.

Another reason can be traced to the establishment of foundries within manufacturing plants. Concerns which use large amounts of foundry products as component parts of their finished articles have transferred their orders from jobbing foundries to a department of their own business. Not only has this transfer decreased the available orders for jobbing foundries, but in slack times it has forced the foundry connected with a manufacturing establishment into the open market as an active competitor of the jobbing plant. This duplication of equipment has caused part of the over-expansion in this industry.

Competition

The result of this over-expansion has been cut-throat competition and price-cutting among the foundries. Foundrymen advance two reasons for cutting prices. The first is that they must keep the plant running. Some express a desire to keep their employees together, while others think mostly of the high overhead which they must shoulder at all times. There is, however, a more fundamental reason for price-cutting in the method of basing prices on weight and the lack of uniform cost systems in the industry.

It is only within the past few years that foundries have adopted cost systems and in only a few cases have these resulted in standard costs which permit adequate price quoting. Originally prices of castings were quoted on a per pound basis over a period of time and the manufacturer would order any casting which he needed. Later foundrymen introduced a few classifications by quoting different prices for castings under 20 pounds and over 20 pounds. They have been loathe to admit that they are not in the business of selling metal and most of them have persisted in quoting prices at so much per pound on the estimated number of pounds in the casting. At the present time this practice may be followed only in isolated areas, but it has resulted in many foundries' accepting prices for castings at the same price or slightly below the

price quoted by a competitor. The general feeling seems to be, "If Smith can do it, I can do it for less." Perhaps some day it may be regarded as unethical to make up losses on some orders by large profits on others. That is what really happens under the present system of basing estimates on pounds. The metal, after all, is only a portion of the cost of the finished casting. (Man-hours would give a much fairer basis for the purpose of estimating the price.)

In addition to the competition of one gray iron foundry with another, the industry as a whole is face to face with the problem of the new competition which has confronted so many industries. At first it was malleable iron and steel competing with gray iron. The general trend in the iron and steel industry since the discovery of the Bessemer process has been the replacing of iron by steel. This shift has come upon the gray iron foundries when they have seemed oblivious of changing business demands. The malleable iron foundrymen, when faced by an almost identical condition, formed an association for the purpose of educating consumers to the advantages of malleable iron. It was only in 1928 that the gray iron foundries formed the Gray Iron Institute.

The shift from iron to steel is also illustrated within the gray iron foundry. Within the recent years the use of scrap iron and steel has increased in proportion to that of foundry pig iron. The chart of raw stocks indicates this increase. The figures are taken at the end of the month as representing an average of stocks on hand. For a single month the figures might very well be said to have little significance, but they are accurate enough to indicate trends. From this chart one can easily see that pig iron on hand has decreased more since 1926 than has scrap. There was a further change from iron to steel which is not shown by these figures and can be obtained only from interviews with foundrymen: the composition of the scrap used in changing from scrap iron to scrap steel. There is also an increasing use of alloys such as aluminum, nickel, and chromium.

At the present time the whole foundry industry—gray iron, malleable iron, steel and non-ferrous—face competition from

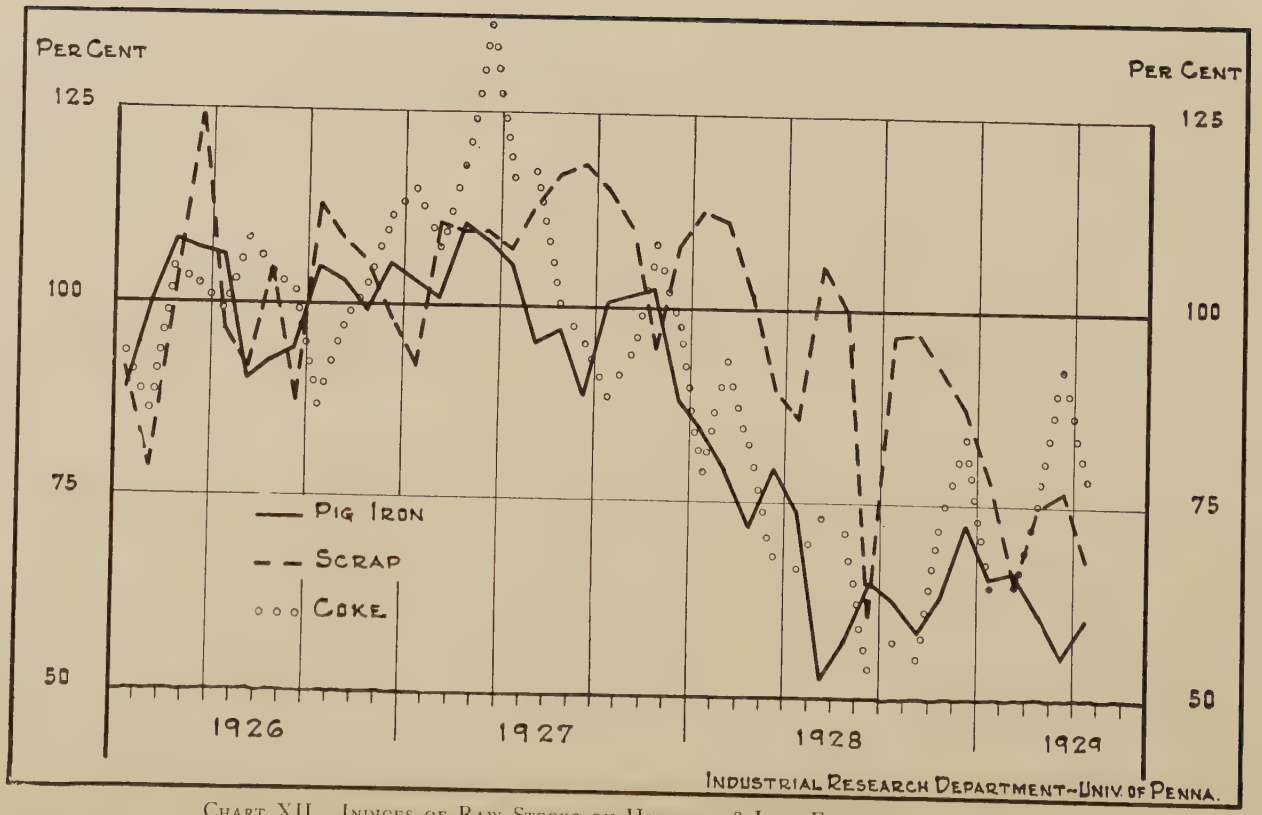

CHART XII. INDICES OF RAW STOCKS ON HAND IN 28 IRON FOUNDRIES, 1926–1929
BASE-AVERAGE OF 1926

another process. Stamped, forged, welded and rolled products are replacing cast products in many fields. The foundries evidently were slow to evaluate the inroads made upon their markets. It was not until October 1927 that an article appeared in *The Foundry* calling attention to this crisis. Within the next three months, six articles and editorials were written dealing wholly or in part with this subject. This fact indicates that foundry leaders are trying to combat the present tendency.

One very favorable indication at the present time deserves comment. Foundries are not encumbered with a large amount of stocks on hand. In fact, the tendency since 1928 has been to carry a negligible amount.

The Trend of Production in Malleable Iron Foundries

The Philadelphia area is not a center for the production of malleable iron castings. Only four malleable iron foundries are included in our reporting.

Fortunately, a general index for the malleable branch is furnished by the Department of Commerce. This includes 137 foundries in the various states.

In Chart XIII the data of the Department of Commerce are compared with those of the group of Philadelphia plants. Considering the fact that malleable firms, in some areas included in the figures of the Department of Commerce, must be engaged wholly upon automotive specialties, it is surprising that the small group of Philadelphia firms conforms so closely to the general trend. The curves parallel each other in all major swings.

In 1928 the Philadelphia group had well-sustained and unusually stable operations, with steadily improving activity in each of the spring months. The upward trend in 1929 carried the production of March nearly to the high point reached in the previous year.

Like that of gray iron foundries, the malleable production shows seasonal irregularity. Normally the peak of activity occurs in March, with some slowing down in the last half of

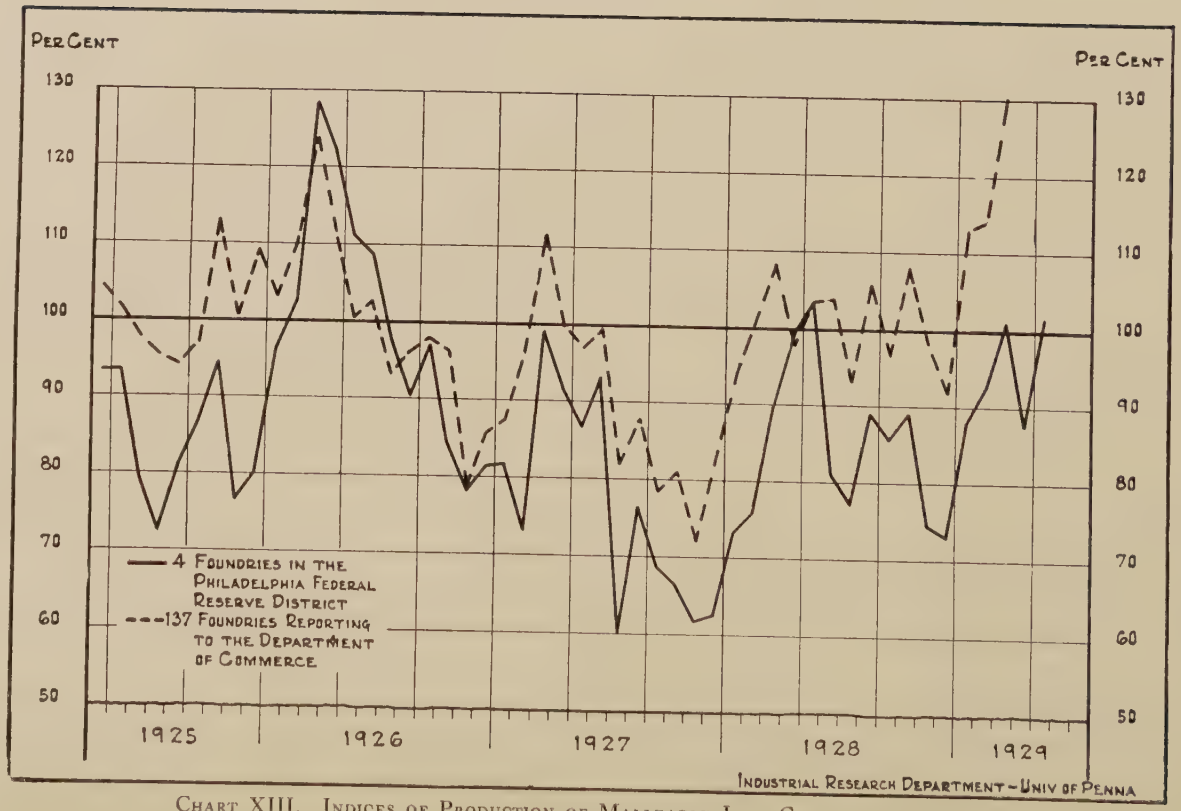

CHART XIII. INDICES OF PRODUCTION OF MALLEABLE IRON CASTINGS, 1925–1929
BASE-AVERAGE OF 1926

the year. Nineteen hundred twenty-five is the only year in which the Philadelphia group showed any constant increase after the recession in the middle of the year.

Were no data available for a large group of malleable plants, one would feel skeptical of the use of a record of four plants. The general conformity of the two curves indicates that it would be valuable for these four firms to plot their monthly data regularly with that supplied by the Department of Commerce in its *Survey of Current Business*. While the local curve tends to lag one or two months, usually two, behind the Commerce curve, the major swings of the two curves are similar.

It should be noted that the Philadelphia firms have not relatively retained the share of the malleable business which they held in 1926. In fact, the space between the two curves seems to be widening in 1929. The Commerce curve in March was 25 per cent above the monthly average of 1926 at a time when the Philadelphia curve had just reached the average of that year.[7]

[7] Owing to the small number of firms in the group, we are not publishing the prices per pound of malleable castings.

STEEL FOUNDRIES

The Tonnage Produced in Steel Foundries

Though there are only 12 steel foundries in the reporting group, the monthly tonnage is as large as is produced by the 37 gray iron foundries considered in the first section of this report. At present the monthly tonnage of the group is about seven and one-half thousand net tons, indicating that the unit of production is large by comparison with gray iron establishments.

Little of the production is for further manufacture in the firms with which the foundries are affiliated; consequently the output can be considered as jobbing work.

The past four years give a picture of extreme fluctuation in the volume of output from month to month. The time of variations seems unpredictable. Neither a recurrent seasonal variation nor consecutive months of sustained activity are evident. The nearest approach to a normal seasonal upward direction occurs in June, but, though the direction of June is upward, this was the high peak of the year only in 1926 and 1928.

Chart XIV shows that the largest tonnage was produced in 1926 in June and December; in 1927 in January and March, and in 1928 in February and June. This year (1929) the general level of production is high and activity has been sustained over a longer period than in any other part of the record. May production was 17.2 above 1926 and 71.9 and 46.1 per cent above the same month in 1927 and 1928. At the moment, the most significant fact shown in the steel castings production is the sustained activity of the past three months in a period when decreases were reported in each of the three previous years.

A comparison of the 12 firms in the Philadelphia group with 130 steel foundries reporting to the Department of Commerce

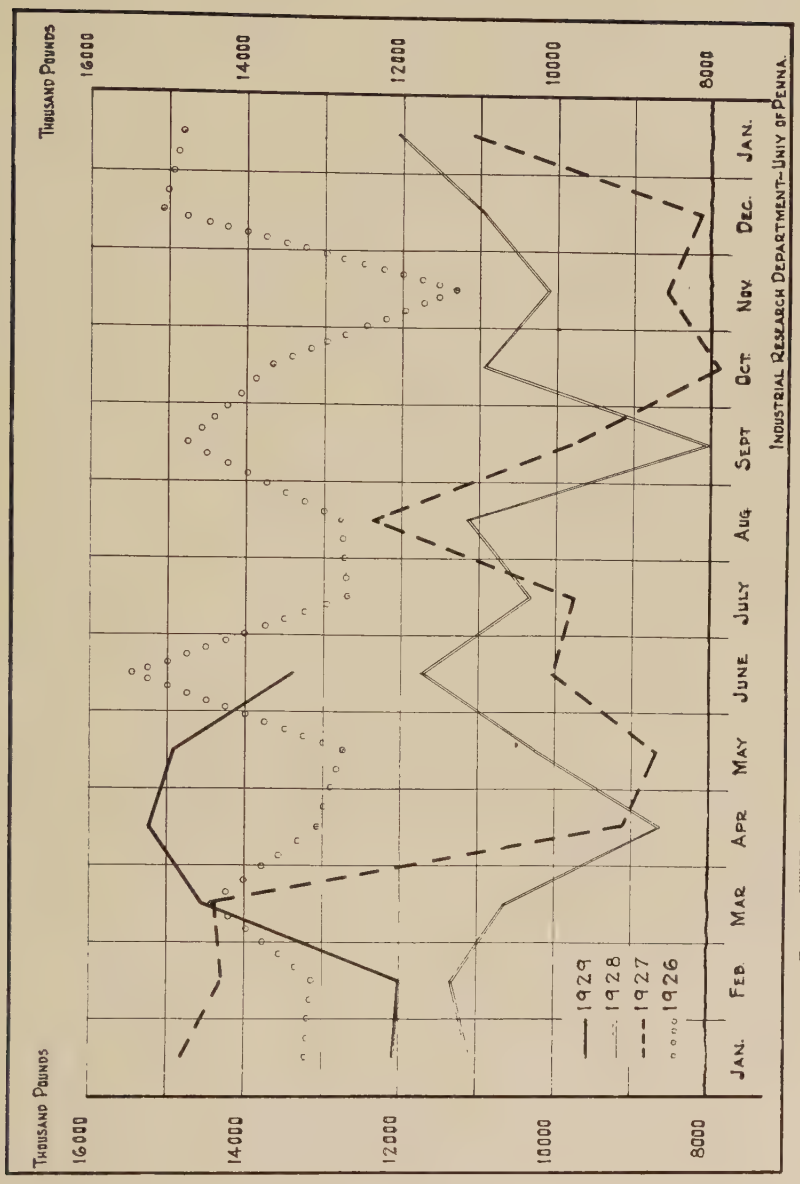

CHART XIV. PRODUCTION OF STEEL CASTINGS IN 12 FOUNDRIES, 1926–1929
ABSOLUTE NUMBERS IN THOUSAND POUNDS

shows that the present activity in Philadelphia plants is in line with a general upward movement throughout the steel branch of the founding industry.

The Commerce curve, with its 130 firms, is free from many of the minor variations evident in the Philadelphia group. A recurring seasonal peak in March of each year seems clearly marked. The two curves tend to follow each other in the major swings. If, however, the curves are closely studied, a divergence in the local curve may be noted. In 1926 in the Philadelphia curve, despite the see-sawing up and down from month to month, the level of production in the last half of the year was as high as in the first half. On the other hand, the Commerce curve declined steadily from March to October. For the next five months, when the Commerce curve rose, the Philadelphia plants maintained a fairly steady output. If one were attempting to follow the curves in this period of eleven months, the trend of the one would not have given much sign of the probable movement of the other. In the decline of 1927, Philadelphia experienced a more drastic recession than is shown in the general curve.

Since 1928 the two curves correspond quite closely even in minor swings. However, it may be of local interest to point out that the 12 Philadelphia plants have not as large a proportionate share of the present active business as they had in 1926. Perhaps they had an undue share in that year. Perhaps their sustained activity at the end of 1926, when other firms were declining, makes 1926 too good for a base year. At the moment, the two groups are moving upward together at a pace which has carried both curves far above the average of 1926.

The object of comparing the two curves is to determine their value to local steel foundry executives. In the case of malleable iron, we concluded that the Department of Commerce curve should be used instead of ours by local plants. We are not ready to make this statement in the case of steel production. The long-time trend is more clearly evident in the figures of the Department of Commerce.

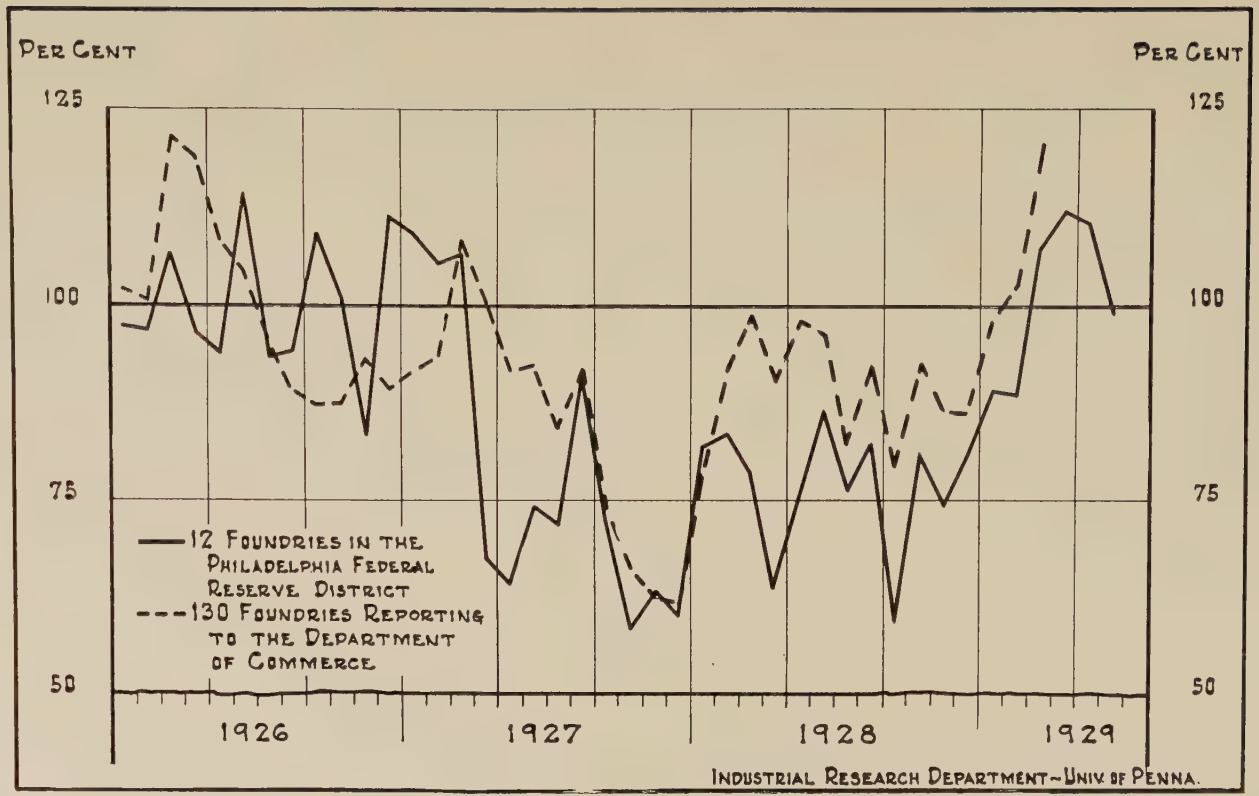

CHART XV. INDICES OF PRODUCTION OF STEEL CASTINGS, 1926–1929
BASE-AVERAGE OF 1926

Local factors seem to dominate the short-run trend for considerable periods. Both curves seem to have separate uses.

Shipments of Steel Castings

The tonnage shipped and the value of shipments show some of the characteristics found in the gray iron figures. There is the same tendency towards a spread between the value and tonnage curves in recent months. The widening of the area between the price and tonnage curves began six months later in steel than it did in iron and the widening has been less noticeable. The price curve tends to extremes in busy months, usually moving upward more slowly than tonnage, only to rocket in a single month to some erratic peak. The figures of the last two years show fewer of these extremes. This tendency to more gradual swings in price is encouraging at a time when production is more than 20 per cent above the average level of 1926.

All of the difficulties cited in connection with a *price per pound* of gray iron castings apply to such an average for steel castings. In fact, the figure is for producing units of widely varying size.

While the 12 plants can be classified neatly into 3 groups of 4 each, the four small concerns have an average monthly capacity of 285 net tons, the four medium-sized 663 net tons, and the four large 2700 net tons. In other words, it takes the nine smallest steel foundries together to equal the capacity of the two largest units in our reporting concerns. If, as one steel executive writes, "the small foundries and large foundries have relatively little in common with reference to production and value of castings shipped," our price figure will be unsatisfactory until the number reporting is increased.

An analysis of the prices of individual plants indicates that there is a tendency, either because of the class of work or on account of other factors, for the highest prices to obtain for the tonnage of the small plants. With one exception, the lowest average prices in May 1929 were reported by the large plants. This means that if production should be disproportionately low in any month in one of the three large plants,

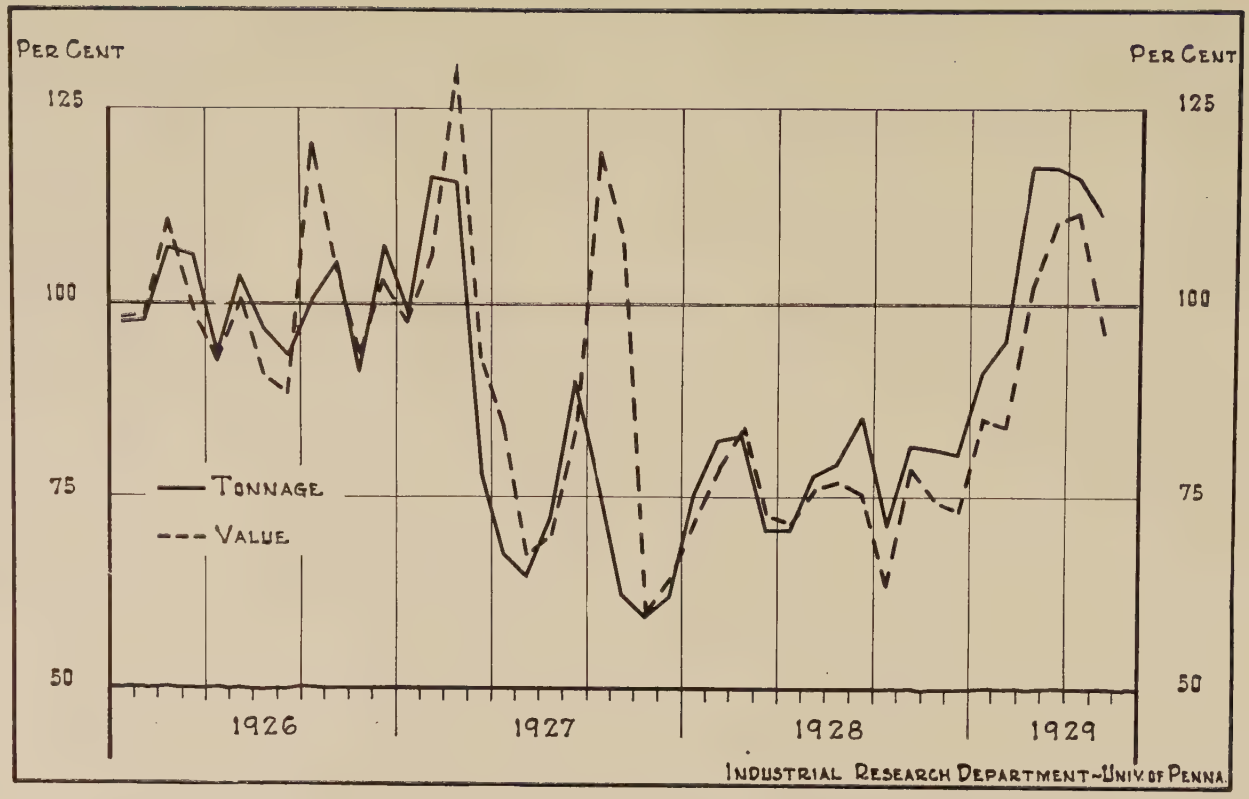

CHART XVI. INDICES OF TONNAGE AND VALUE OF SHIPMENTS OF STEEL CASTINGS IN 12 FOUNDRIES, 1926–1929
BASE-AVERAGE OF 1926

our average price might seem to increase without any change in the scheduled prices of any firm. The table of prices per pound is given with this necessary caution.

TABLE 9

AVERAGE PRICE PER POUND OF SHIPMENTS OF STEEL CASTINGS

Month	1926	1927	1928	1929
January	.0806	.0793	.0769	.0747
February	.0803	.0735	.0766	.0709
March	.0830	.0899	.0811	.0694
April	.0749	.0957	.0826	.0756
May	.0799	.0997	.0813	.0772
June	.0777	.0845	.0786	.0693
July	.0755	.0778	.0783	
August	.0761	.0747	.0709	
September	.0961	.1240	.0720	
October	.0796	.1412	.0772	
November	.0820	.0810	.0733	
December	.0768	.0834	.0725	
Yearly average	.0802	.0904	.0767	

The average price in 1926 was 8 cents per pound; in 1927 it was as high as 9 cents, owing to unusually high averages in September and October. Since April 1928 there has been no month with an average of 8.3 cents and a trifle over seven and one-half cents is more usual. Disregarding the group average and considering the individual concerns, there is a range in plant averages from less than 6 cents to a trifle over 17 cents per pound. Five plants reported an average of more than 10 cents per pound.

UNFILLED ORDERS

The value of shipments and the value of unfilled orders offer contradictory trends—not an unusual situation in unadjusted data. The rapid booking of orders in 1929 seems halted without any slowing down in production.

The indices of physical volume of production and unfilled orders are more consistent than the curves of value. But in unfilled orders the trend over a considerable period is more reliable than the immediate monthly relationship.

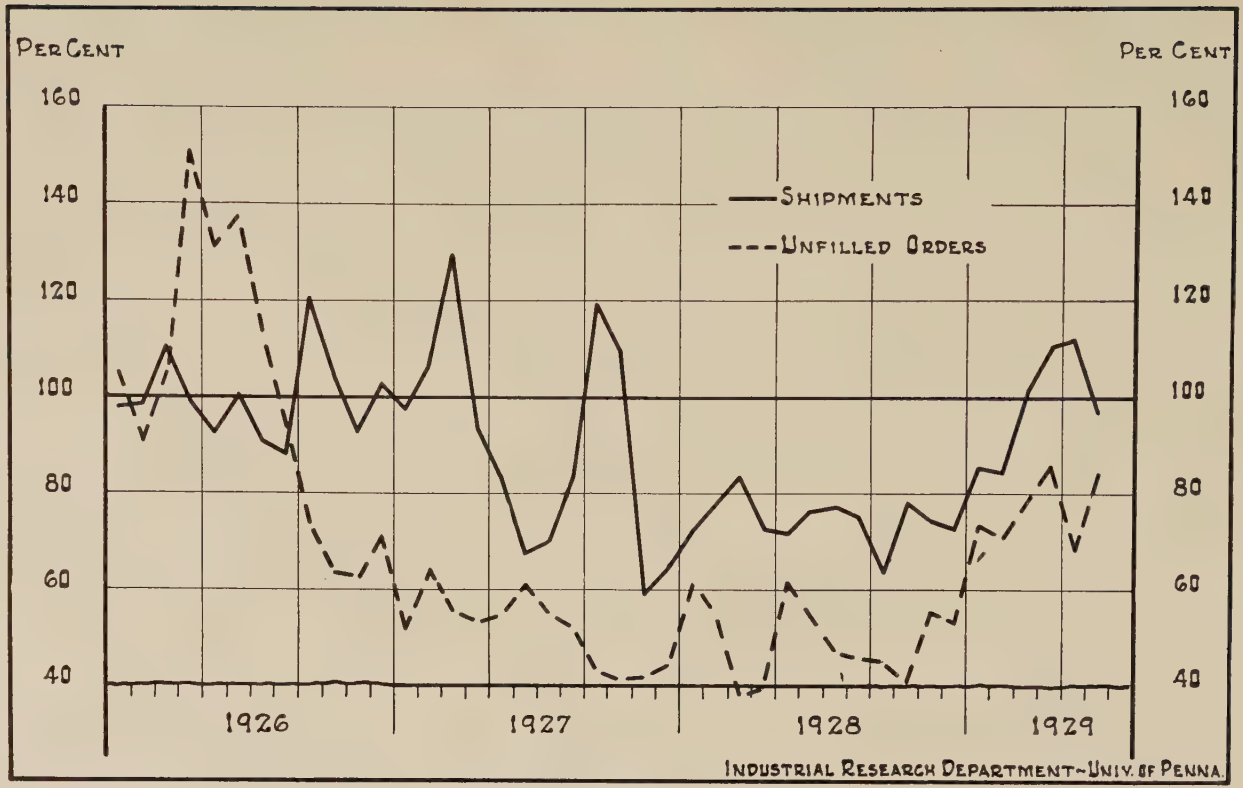

CHART XVII. INDICES OF VALUE OF SHIPMENTS AND OF UNFILLED ORDERS IN 12 STEEL FOUNDRIES, 1926–1929
BASE-AVERAGE OF 1926

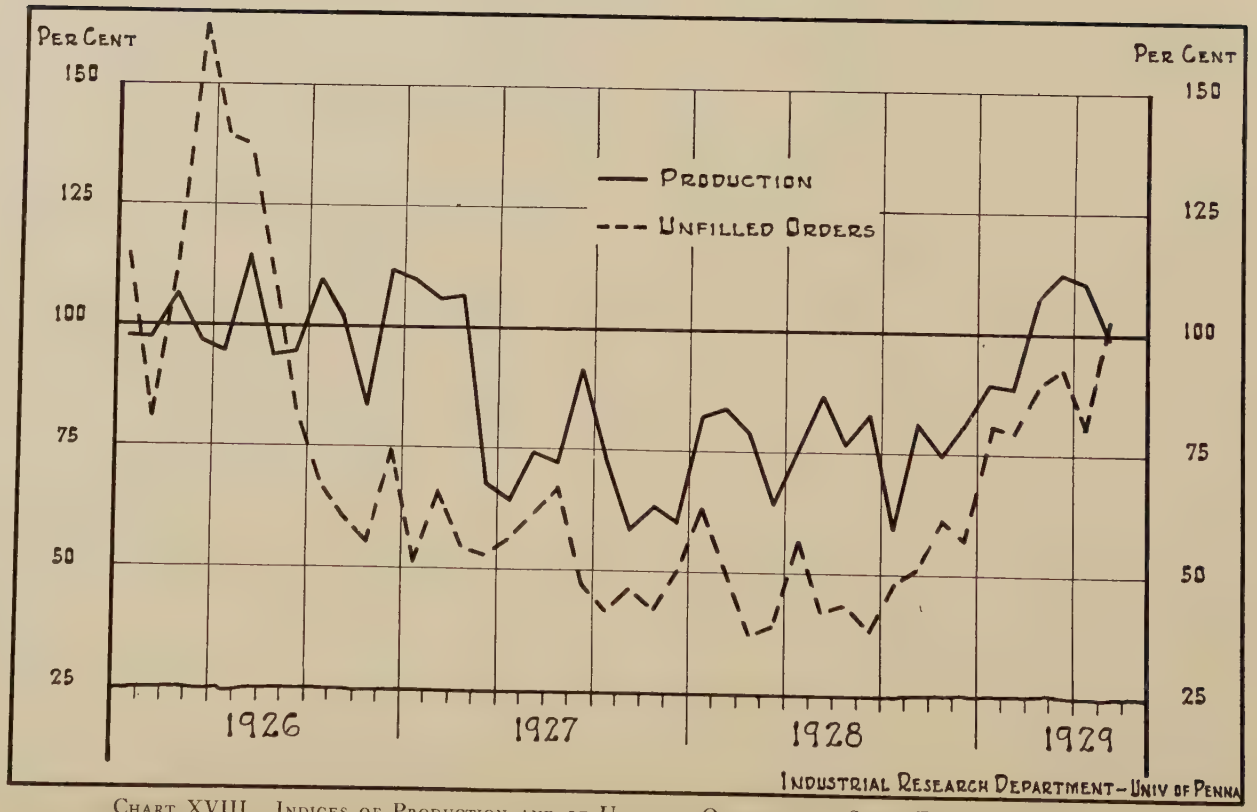

CHART XVIII. INDICES OF PRODUCTION AND OF UNFILLED ORDERS IN 12 STEEL FOUNDRIES, 1926–1929
BASE-AVERAGE OF 1926

The Ratio of Production to Capacity

The steel foundries are at present operating at about 60 per cent of capacity. In the past three years they have had a few months as low as 31 per cent and others as high as 60 or 61 per cent. The best year of the period, 1926, showed relatively active operation at a ratio of 53.7 per cent of capacity. In the next two years the ratio was 42.4 and 41.5 respectively. A changed situation is evident in 1929. The percentage of activity was higher, even in January, than in any month in 1928 and by March only 40 per cent of the full capacity of the plants was unused.

TABLE 10

Ratio of Production to Capacity in 12 Steel Foundries by Months

Month	1926	1927	1928	1929
January	52.5	58.8	44.1	47.9
February	52.2	56.8	45.0	47.7
March	57.4	57.2	42.4	57.8
April	51.9	36.3	34.4	60.5
May	50.6	34.5	40.6	59.3
June	61.4	40.0	46.7	53.4
July	50.4	38.9	41.1	
August	50.7	49.1	44.3	
September	58.6	39.0	31.9	
October	54.3	31.4	43.6	
November	44.9	34.0	40.1	
December	60.0	32.4	43.5	
Yearly average	53.7	42.4	41.5	

Raw Stock

With production above the average of 1926 at present, the plants are reporting a smaller amount of raw stock on hand than was carried in 1926 or 1927. The amount of pig iron on hand is about 50 per cent below the average of 1926; the amount of scrap is higher proportionately than pig iron, though both are below 1926.

New Orders for Steel Castings

The steel branch of the foundry industry is relatively new. It is regarded by some as a powerful competitor to gray iron.

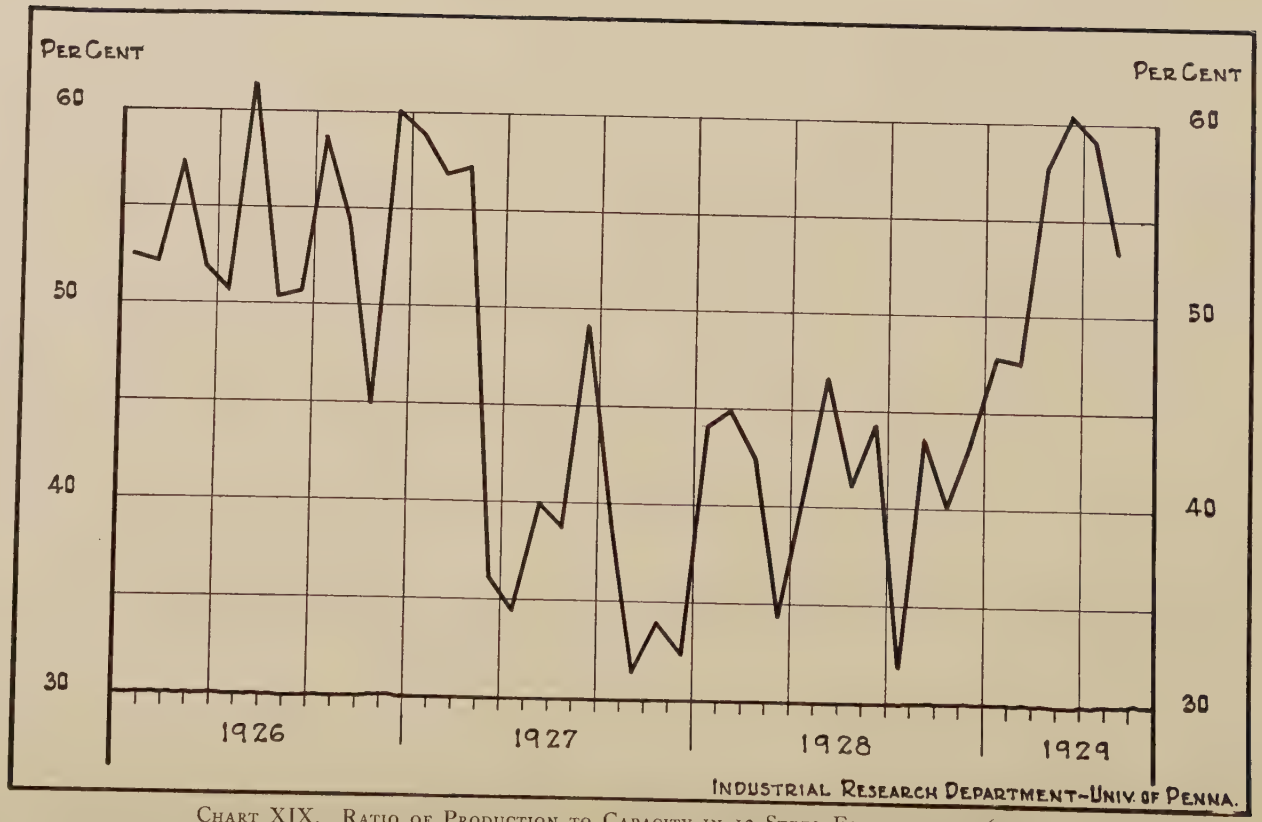

CHART XIX. RATIO OF PRODUCTION TO CAPACITY IN 12 STEEL FOUNDRIES, 1926–1929

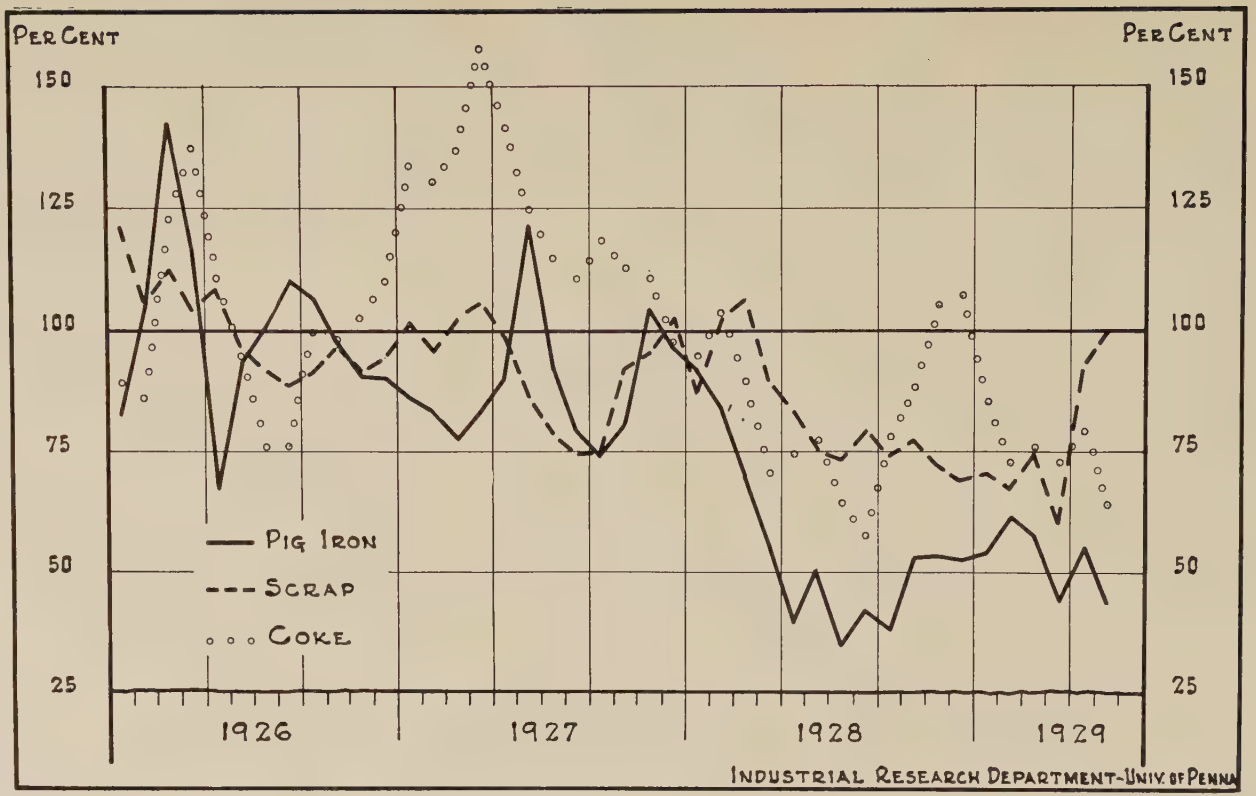

CHART XX. INDICES OF RAW STOCKS ON HAND IN 12 STEEL FOUNDRIES, 1926–1929
BASE-AVERAGE OF 1926

Does the industry show rapid expansion? Our production curves cover too short a period to answer this question and we have again turned to the Department of Commerce. In these data the record of *new orders* for steel castings is given for 130 firms. The new orders are available from 1920 to date. Over a nine year period, if the industry were displacing iron founding, there should be a rapid increase in new orders. A study of the new orders shows no such increase.

The trend of the period is shown by the straight line fitted to the data of 1920 to 1928 inclusive. The slope of the line is very slightly upward, showing neither growth nor recession. If the orders of 1929 continue at the present rate, the line of trend will be a little steeper, but such a situation is unlikely in the light of the records of previous years.

Would the production of steel castings show a more rapid rate of growth than is shown by new orders? If not, the fear of the competition of steel foundries is exaggerated in the other branches of the industry. The steel foundries show less increase than would be expected in a decade from the normal growth in business in general.

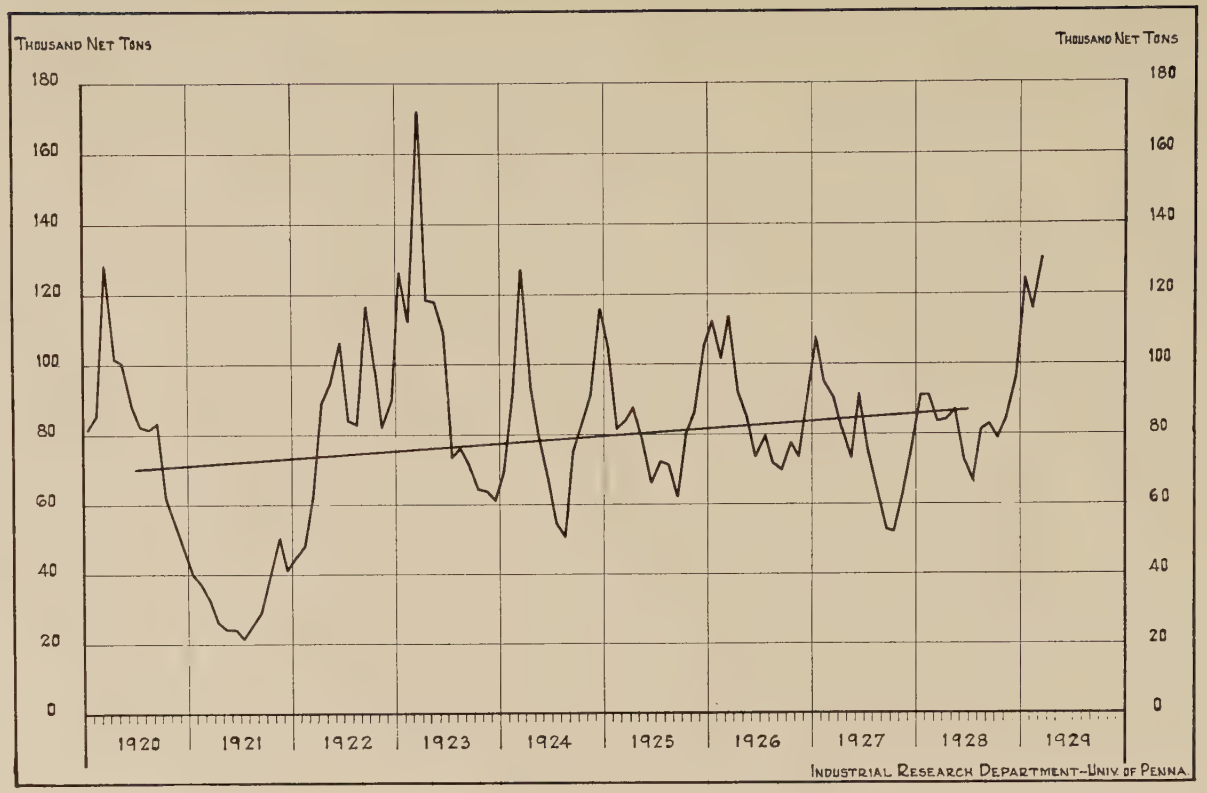

Chart XXI. New Orders for Steel Castings, 1920–1929

SUMMARY

Some of the indications of this study can scarcely be called conclusions. They are not final. They are signs which executives should watch, if any measure of stability is to be attained in the industry.

Even the year 1926, upon which our comparisons are based and in which the industry shared in the general prosperity, one of the large sources of orders brought little demand. The year started with more than its quota of optimism. All through the first half of 1926, the foundries shared the benefits of a brisk demand in automotive manufacturing, agricultural implements, household equipment and building construction. It was expected that orders for railway equipment would replace the automotive orders as the season advanced and the normal slackening in motor demand occurred. The opposite happened. The orders for railway equipment never appeared; the automotive demand continued at a high pace until June and was well-sustained for the rest of the year. April approached closely to the record.

What effect upon the ratio of production to capacity would a balanced demand for railway equipment have made? This source of orders is influencing the 1929 figures; it was lacking in 1926. Even in the peaks of both periods, the gray iron foundries in this study had an excess capacity of 41 per cent, and the steel foundries fully 39 per cent. At best the groups averaged very little over 50 per cent of their maximum for the whole year.

It is a fair question to ask what part of full capacity is practically attainable in a seasonal industry. A few exceptional foundries depend upon special side-lines of their own to stabilize production; most experience the seasonal irregularity of the industries for which they produce. The stove, radiator and furnace branches have their busy season in late summer and early fall; it is exceptional for active demand for

stove castings to continue into the winter months. Garden and farm equipment have their rush in early spring; the peak of motor business in castings is over by June. The gap between the various periods makes for spotty production with plants working overtime in one week and often dropping to two or three days in the next. Again a plant specially equipped may be idle when others are booming.

The percentage of capacity practically attainable in one branch of the industry may be low for other branches. What dependence can be placed upon comparisons of the rate of operations when all branches are combined?

Again, the methods of figuring capacity are at variance. The steel foundries use actual production for a past period, usually the average of the five best months since 1920; the malleable foundries use a standard formula; the gray iron foundries have not agreed upon any uniform procedure. The Ohio State Foundrymen's Association bases its compilations upon "normal production." In our figure we use the maximum producing power of the plant on the average kind of work run in the shop if all the capacity were active.

At first thought, foundrymen usually insist that our figure will always magnify the attainable capacity of any given plant. This is not true. A number of our foundries show a rate of operation of 97 to 100 per cent in 1926. When one of the same foundries drops to 19 per cent in 1928 we feel satisfied that there can be as great extremes in activity as our figures show.

The matter of figuring an attainable capacity for gray iron foundries in not purely a question of definition or formula; though this is important, it is not the starting point in developing dependable records. The demand for castings fluctuates with the series of periodic and seasonal fluctuations in the business of consumers. Until the most important products in this demand can be classified, the cause or extent of fluctuations in production cannot be explained. The starting point for the improvement in gray iron figures of production, or rates of operation, is a classification of foundry products.

The steel branch of the industry, by a separate classification of railway specialties, is able to find out the effect of one-third of its source of demand. It is not essential in gray iron to attempt to classify all miscellaneous products; it is essential to know the fluctuations in the major types of orders. Any attempt to ameliorate the seasonality through overlapping of work by balancing orders from industries with different busy periods, any attempt to build up a backlog of specialties to tide over inactive peaks, or any attempt to budget upon a practicable ratio of production to capacity depends upon knowing the recurrent and dependable part of the consumption which can be reasonably expected in different months. For this a classification of foundry products is essential.

Even without a classification of major products, some of the findings in gray iron are definite. The jobbing foundries have operated as regularly as those connected with manufacturing plants in all years and have shared more largely in the recent activity than the manufacturing foundries. The figures show that the small foundries operated by manufacturing plants have a low ratio of activity in periods when they must seek outside orders. They also recover slowly from a period of recession. Considering the amount of excess capacity in the industry, a manufacturing concern should hesitate before starting a small foundry unless it can be wholly self-sustaining. The large manufacturing foundries are better integrated and seem able to share proportionately in the demand of the industry.

Obviously the value of shipments fluctuates both with the volume of tonnage and the price per pound of castings. This is not all. The demand of different months may come from different sources and call for castings of different types. The shape of the casting, not its weight, determines the foundry cost of production. Consequently a variation in the price per pound would mean more if castings could be classified by type instead of by weight.

Our curves of shipments show a variation between price and volume which cannot be explained by seasonal changes.

For 16 months the curve of value of shipments (in dollars) has veered away from the curve of tonnage shipped. From this we conclude that some of the increase in business in 1928 and 1929 has been secured by a considerable lowering of prices. The average price per pound of gray iron castings has moved gradually downward from 6.3 cents in 1926 to 5.6 cents in 1928. A turning point seems likely in this trend from the rather general increase in prices in May 1929. The average of the month was .4 cents above that of April as the result of a slight increase in almost every one of the 33 plants.

There are no comparable figures with which to test our gray iron curves of production. The production of steel castings in the locality has been compared with 130 steel foundries throughout the United States which are reporting to the Department of Commerce. The comparison shows that the local curve and the Commerce curve follow each other in the major swings. In the minor fluctuations local factors dominate for considerable periods. The correspondence in the two curves is sufficiently close to show that the local curve is representative enough to be reasonably dependable. If special factors influence other localities, a geographical separation of the Commerce figures would be helpful.

The production of malleable iron castings by local firms was compared with that of 137 reporting to the Department of Commerce. There was little variation in either the time or direction of fluctuations in the two series. Since the local curve could be enlarged by only a few plants, and since the correspondence is close, the curve of the Department of Commerce seems to serve best all purposes of comparison.

Lacking a general curve for gray iron castings, the index of production was compared with the output of pig iron in Pennsylvania exclusive of Pittsburgh. The chart discussed in the first section of this study should really be divided into two parts, the period from 1924 to 1926 and the period from 1926 to date. In the first period the pig iron curve took extreme dips. In general, however, castings coincided with pig iron at peak periods and preceded it in declines. From

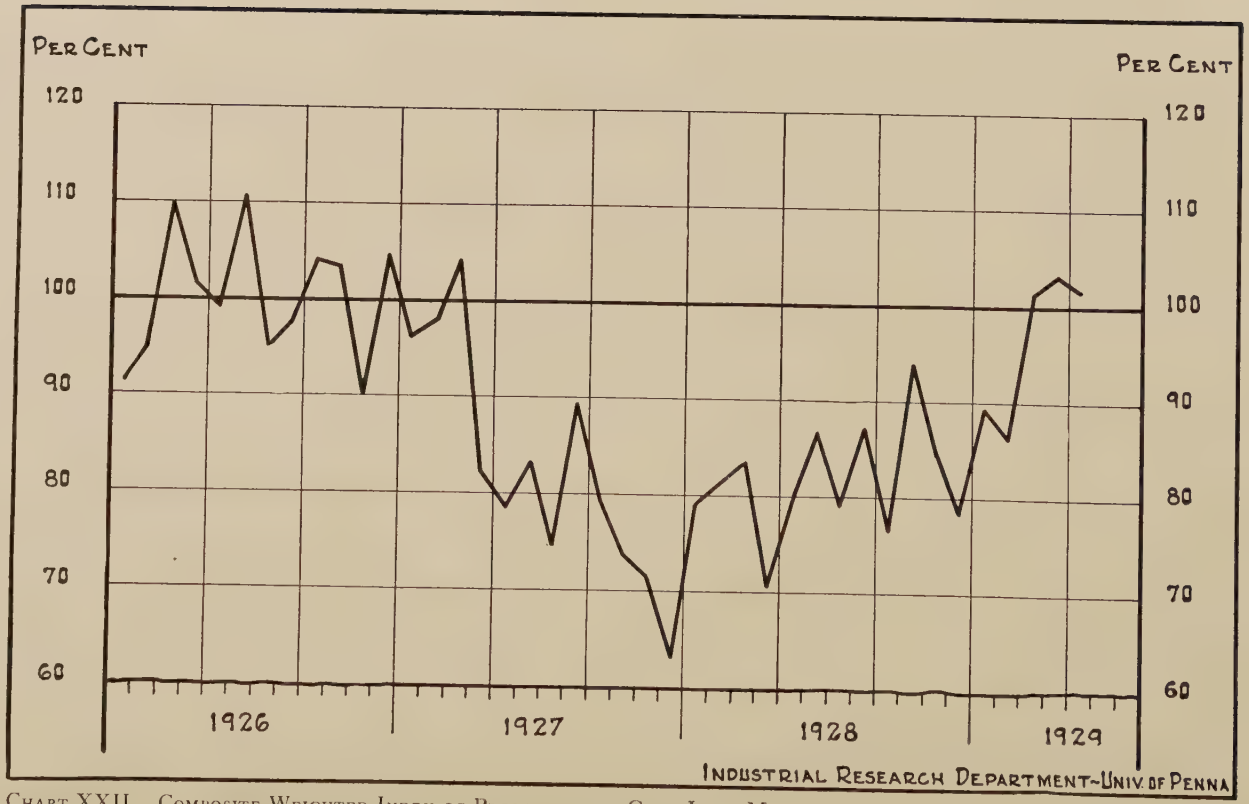

CHART XXII. COMPOSITE WEIGHTED INDEX OF PRODUCTION OF GRAY IRON, MALLEABLE IRON AND STEEL CASTINGS, 1926–1929
BASE—AVERAGE OF 1926

1926 to date the two curves show a consistent relationship with a definite lag, usually two months, on the part of pig iron production—a lag which is easily explained by the difference in processes. If pig iron production is to be reduced, a whole producing unit, a blast furnace, must be closed. This necessity, coupled with the fact that pig iron can be stored, makes the output respond slowly to a change in demand. The gray iron curve of production responds quickly. It is this sensitiveness of foundry output to changes in demand which gives it significance as a barometer of business conditions. It is believed that if all foundry production were separated solely on the basis of product, the changes in output could be regarded as definite barometers of the corresponding industries.

In some respects the trend of production of all ferrous castings should be considered. The validity of a combined curve for steel and malleable and gray iron castings in the area depends upon the representative character of the firms in the reporting groups. The tests already cited give a presumption of reliability. Consequently an index for all ferrous foundries in the Philadelphia area was compiled by weighting the relatives for each branch of the industry by its proportionate tonnage in each month.

The curve shows, more clearly than the separate relatives for each branch, the three distinct periods in activity.

The high level of 1926 lasted till April 1927; the downward swing lasted until the end of 1927, when the present gradual upswing began. The definiteness of the curve makes one wish that a record over a longer period were available.

General figures are available for malleable iron and steel castings. If this study serves to show the value of a similar record of gray iron output to industry and to students of industrial changes, it will have served its purpose. If it should further induce foundrymen to attempt to classify foundry products, a better basis for planning in the industry would be established.

APPENDIX

There is little in the method of presentation of this study which needs explanation. The monthly production of gray iron and steel castings was shown in absolute figures of tonnage. Other charts are simple relative figures based on the average monthly record in 1926. If a longer series were at hand, it would be advisable to correct the data for the marked seasonal irregularity. No such smoothing has been undertaken.

Though no comment on the analysis is necessary, it is desirable to explain the method of collecting data and the units employed in the discussion.

The value of a current record of foundry activity was first realized by the Philadelphia Federal Reserve Bank. In the winter of 1923–1924, Mr. Thomas Ellis, then a senior in the Wharton School of Finance and Commerce at the University of Pennsylvania, made an investigation, under the direction of Professor Dewhurst, to prepare the plan for the establishment of a reporting system for the foundry industry. In this survey, as a representative of the bank he had the support of the foundrymen's associations and the Metal Manufacturers' Association. The Federal Reserve Bank, as a result of the preliminary survey, set up its method of reporting and compiled monthly summaries which were distributed to the reporting firms. The first release covered conditions in March 1924. The group of plants was increased from time to time. In 1925 the study was enlarged by the addition of several more steel foundries.

Late in 1927 the Philadelphia Federal Reserve Bank asked the Industrial Research Department of the University of Pennsylvania to assume the task of collecting and analyzing the monthly reports. Beginning with January 1928, this department has prepared a bulletin each month which has been sent to the contributing firms and to journals in the trade.

In extending the scope of the reporting group, and in reconsidering the value of foundry data to the trade, the Research Department had the advice and help of a committee of foundry executives with Mr. William Sauter of the American Engineering Company as chairman.

The Research Department has in addition verified and completed back records for several firms which had been reporting, added several more firms to the group, changed the unit of reporting from tons to pounds, and defined several terms which had been indefinite.

The original form of reporting was continued, and the questionnaire in use is given on the following page. The form is simple and requires little explanation.

No.

CONFIDENTIAL REPORT ON THE FOUNDRY INDUSTRY

to the

FEDERAL RESERVE BANK OF PHILADELPHIA
AND THE INDUSTRIAL RESEARCH DEPARTMENT OF THE UNIVERSITY OF PENNSYLVANIA

for the month of

This form is to be used for reporting confidential statistical information for your firm. Please fill in the information asked for, retaining the yellow copy, and mail the white copy in the enclosed addressed envelope at the *earliest date possible.*

1. PRODUCTION of good castings during month:

	Custom or jobbing	*For your own use or for further manufacture in your own plant.*
Gray iron	_____ lbs.	_____ lbs.
Malleable iron	_____ lbs.	_____ lbs.
Steel	_____ lbs.	_____ lbs.
Non-ferrous	_____ lbs.	

2. SHIPMENTS of good castings during month _____ dollars
(In addition to castings actually shipped, include weight and value of castings produced by you for your own use or for further manufacture in your plant. Do not include value of any machining upon castings.) _____ lbs.

3. UNFILLED ORDERS on hand last day of month _____ dollars
(This includes all orders for which goods have not been shipped.) _____ lbs.

4. RAW STOCKS on hand last day of month
pig iron _____ lbs.
scrap _____ lbs.
coke _____ lbs.

5. REMARKS: Please note any change in equipment of foundry and any special circumstances which would affect the significance of your figures:

_____

_____

Name of Firm _____ Signature _____

Location of Foundry _____ Title _____

The problem of defining capacity has been already discussed.

Some difficulties were met even in the definition of production. The interest of this study is only in usable castings and the inclusion of the total of good and spoiled castings in the production figures of a few plants made necessary much revision.

The shipments include those for the foundry's own use or for further manufacture in the plant as well as those actually shipped. The tonnage is fairly clear and involves few difficulties.

The confusion comes over the value of shipments. The figure which it is desirable to get is the value of castings before any machining work has been done upon them. The problem is illustrated by the statement of one of the participants:

"Our firm does not ship castings—castings become finished such as boilers, furnaces, tanks and heaters. This means that they are machined, mounted, erected and crated before leaving the foundry, but the figures given to you for our foundry are values before machining."

Tonnage

The use of long and short tons varies in the industry. Pig iron and scrap are likely to be reported in long tons and coke in short tons, the usual unit of purchase. At the suggestion of the Foundry Committee, the plan of having all data reported in pounds was adopted.

The questionnaire calls for little data which it is unusual for even small foundries to need for their own monthly summaries. If the same form could be used by foundry associations in other areas, especially in the gray iron branch of the trade, for which no general index is available, our data as well as theirs would be enhanced in usefulness.

The tables upon which charts are based are given in the following pages.

TABLE 1–A

Production of Gray Iron Castings in 37 Foundries 1926–1929

(Absolute numbers in pounds)

Month	1926	1927	1928	1929
January	11,223,978	10,481,236	10,191,877	12,576,011
February	12,498,336	12,022,081	10,610,173	11,568,000
March	15,065,954	13,637,034	11,717,175	13,194,000
April	14,266,061	12,470,106	10,495,621	13,195,000
May	13,946,763	11,988,645	11,698,193	12,918,000
June	14,422,023	12,262,613	12,102,597	
July	12,967,621	10,499,142	11,334,063	
August	13,664,700	11,935,725	12,964,707	
September	13,219,260	11,557,075	12,610,696	
October	14,270,934	11,558,390	14,732,291	
November	12,954,420	10,699,485	13,127,337	
December	13,072,882	8,990,931	10,880,885	

TABLE 2–A

Indices of Production of Gray Iron Castings in 19 Jobbing and 14 Manufacturing Foundries 1926–1929

(Base-Average of 1926)

Month	19 Jobbing Foundries				14 Manufacturing Foundries			
	1926	1927	1928	1929	1926	1927	1928	1929
January	82.8	86.7	73.8	95.5	83.9	66.0	79.4	82.1
February	88.5	95.4	77.1	85.5	96.5	82.6	81.9	79.9
March	109.2	104.6	89.5	103.1	114.6	98.0	85.3	82.9
April	111.4	96.6	74.2	98.8	97.6	87.7	74.5	86.2
May	99.9	90.5	86.1	99.4	107.7	86.8	78.9	81.3
June	104.8	88.4	86.5		109.4	93.2	88.3	
July	98.2	78.9	82.2		93.7	75.5	82.3	
August	105.3	91.2	94.2		96.6	84.9	88.1	
September	95.7	92.6	90.9		102.6	78.1	85.6	
October	104.7	80.0	110.9		108.9	91.4	96.8	
November	98.0	74.9	98.8		95.0	83.8	86.0	
December	101.6	63.7	82.9		93.4	69.7	68.5	

TABLE 3–A

INDICES OF PRODUCTION OF GRAY IRON CASTINGS IN 21 LARGE AND 12 SMALL FOUNDRIES 1926–1929

(Base-Average of 1926)

Month	21 Large Firms				12 Small Firms			
	1926	1927	1928	1929	1926	1927	1928	1929
January	83.4	77.0	76.6	91.6	82.2	81.5	73.8	74.6
February	92.4	90.6	79.5	83.6	89.5	84.0	76.9	78.4
March	111.3	103.1	87.9	94.8	113.5	90.7	85.8	89.3
April	105.5	94.3	75.7	93.3	104.4	80.1	64.6	92.8
May	103.2	89.8	84.1	91.4	105.0	81.6	73.7	91.8
June	107.4	89.9	88.9		103.2	95.5	75.2	
July	96.7	76.0	82.7		92.8	87.3	78.8	
August	103.0	87.6	92.3		90.5	94.1	85.6	
September	98.4	86.8	90.0		101.2	81.3	77.8	
October	106.6	85.1	107.1		106.3	84.9	86.7	
November	94.7	80.2	96.2		111.1	68.9	70.7	
December	97.6	66.4	77.2		100.5	66.1	72.1	

TABLE 4–A

INDICES OF PRODUCTION OF GRAY IRON CASTINGS IN 15 PHILADELPHIA FOUNDRIES AND 18 OUT-OF-TOWN FOUNDRIES 1926–1929

(Base-Average of 1926)

Month	15 Philadelphia Foundries				18 Out-of-Town Foundries			
	1926	1927	1928	1929	1926	1927	1928	1929
January	92.0	82.0	82.7	102.7	73.2	72.5	68.9	74.5
February	95.3	81.3	86.4	93.8	88.3	99.5	70.9	70.6
March	120.6	96.8	92.6	113.1	101.3	107.3	82.0	72.4
April	113.9	92.9	81.1	109.4	95.5	92.4	66.6	74.7
May	103.7	88.7	92.9	114.5	103.0	89.0	71.5	64.9
June	108.0	89.9	95.2		105.5	91.3	78.1	
July	95.4	78.4	91.0		97.1	76.2	72.2	
August	93.4	90.6	96.3		110.8	85.9	85.9	
September	95.8	97.8	95.1		102.1	72.8	81.2	
October	103.0	91.8	113.6		110.6	77.4	94.4	
November	89.6	81.6	106.0		104.8	75.7	78.4	
December	89.3	75.3	87.1		107.9	56.0	64.5	

See Table 3 in text for Table 5–A.

TABLE 6–A

INDEX OF SHIPMENTS OF GRAY IRON CASTINGS IN 33 FOUNDRIES 1926–1929

(Base-Average of 1926)

Month	1926	1927	1928	1929
January	83.0	83.0	78.4	91.8
February	83.9	84.1	81.8	88.9
March	105.9	98.3	87.9	100.9
April	107.2	95.6	78.2	107.6
May	101.0	83.2	94.8	104.0
June	107.3	91.4	96.8	
July	96.6	89.1	89.9	
August	100.0	96.5	97.1	
September	109.3	108.1	100.6	
October	111.7	97.3	120.8	
November	98.0	90.4	107.4	
December	96.2	80.7	87.5	

See Table 3 in text for production.

TABLE 7–A

INDEX OF VALUE OF SHIPMENTS OF GRAY IRON CASTINGS IN 33 FOUNDRIES 1926–1929

(Base-Average of 1926)

Month	1926	1927	1928	1929
January	84.8	83.0	76.2	80.8
February	87.0	81.8	78.2	81.6
March	100.5	96.9	83.9	87.9
April	102.3	90.1	72.5	93.5
May	99.9	82.2	82.5	96.2
June	101.2	87.6	83.1	
July	97.7	84.6	80.8	
August	95.2	96.6	84.9	
September	115.7	112.7	90.0	
October	116.8	102.6	105.3	
November	101.7	95.7	92.2	
December	97.3	79.0	76.4	

See Table 6–A for index of tonnage

TABLE 8–A

INDICES OF PRICE PER POUND OF SHIPMENTS OF GRAY IRON CASTINGS IN 33 FOUNDRIES AND OF UNFILLED ORDERS FOR GRAY IRON CASTINGS IN 21 FOUNDRIES 1926–1929

(Base-Average of 1926)

Month	Price of Shipments				Price of Unfilled Orders			
	1926	1927	1928	1929	1926	1927	1928	1929
January.....	102.2	100.0	97.2	88.0	99.2	99.9	96.4	81.7
February....	103.7	97.3	95.6	91.8	96.3	104.6	96.1	76.7
March.....	94.9	98.6	95.4	87.1	103.9	114.6	97.1	78.9
April.....	95.4	94.2	92.7	86.9	90.7	101.2	86.8	76.7
May.....	98.9	98.8	87.0	92.5	91.0	104.4	86.3	80.3
June.....	94.3	95.8	85.8		94.6	110.3	86.8	
July.....	101.1	94.9	89.9		98.5	113.5	87.7	
August.....	95.2	100.1	87.4		101.8	113.4	89.4	
September...	105.9	104.3	89.5		101.8	103.9	89.4	
October.....	104.6	105.4	87.2		107.4	104.2	84.4	
November...	103.8	105.9	85.8		105.6	109.2	88.0	
December...	101.1	97.9	87.3		106.7	91.0	84.5	

TABLE 9–A

INDICES OF VALUE OF SHIPMENTS OF GRAY IRON CASTINGS IN 33 FOUNDRIES AND OF UNFILLED ORDERS FOR GRAY IRON CASTINGS IN 21 FOUNDRIES 1926–1929

(Base-Average of 1926)

Month	Value of Shipments				Value of Unfilled Orders			
	1926	1927	1928	1929	1926	1927	1928	1929
January.....	85.1	83.3	76.1	85.2	83.9	73.0	110.5	93.2
February....	88.0	81.9	77.4	85.2	81.7	95.4	119.7	81.9
March.....	103.9	95.7	83.9	91.7	90.2	112.5	127.8	91.2
April.....	103.0	90.4	76.0	96.1	82.0	109.7	129.0	88.9
May.....	100.9	83.3	85.6	99.5	97.3	118.8	130.8	105.4
June.....	102.2	88.5	84.9		105.9	132.6	143.6	
July.....	97.9	84.4	81.1		105.6	131.1	138.0	
August.....	96.1	94.6	88.0		105.7	138.7	153.8	
September...	114.1	107.9	91.6		107.5	144.2	147.2	
October.....	113.9	100.3	107.5		117.1	146.1	130.2	
November...	99.3	94.2	92.7		118.4	130.8	108.6	
December...	95.7	78.0	78.4		104.6	101.4	129.3	

TABLE 10–A

INDICES OF PRODUCTION OF GRAY IRON CASTINGS IN 33 FOUNDRIES AND OF UNFILLED ORDERS FOR GRAY IRON CASTINGS IN 21 FOUNDRIES 1926–1929

(Base-Average of 1926)

Month	Production				Unfilled Orders			
	1926	1927	1928	1929	1926	1927	1928	1929
January	83.4	77.8	75.7	93.4	81.4	73.4	114.2	111.9
February	92.8	89.3	78.8	85.9	82.7	91.2	125.1	103.3
March	111.9	101.3	87.0	98.0	87.9	99.6	130.7	113.9
April	106.0	92.6	77.9	98.0	90.3	110.1	148.2	111.9
May	103.6	89.0	86.9	95.9	106.3	115.3	152.6	127.7
June	107.1	91.1	89.9		111.9	122.9	166.0	
July	96.3	78.0	84.2		107.6	117.9	156.7	
August	101.5	88.6	96.3		104.3	124.8	172.4	
September	98.2	85.8	93.6		105.9	141.4	164.9	
October	106.0	85.8	109.4		109.7	142.8	152.1	
November	96.2	79.5	97.5		113.5	122.1	123.2	
December	97.1	66.8	80.8		98.6	112.5	152.6	

See Table 6 in text for Table 11–A.

TABLE 12–A

INDICES OF RAW STOCKS ON HAND IN 28 IRON FOUNDRIES 1926–1929

(Base-Average of 1926)

Month	Pig Iron				Scrap Iron				Coke			
	1926	1927	1928	1929	1926	1927	1928	1929	1926	1927	1928	1929
January	88.7	103.0	84.5	65.8	91.6	92.3	112.6	78.0	93.9	115.0	79.4	64.7
February	99.8	100.8	80.6	66.5	78.7	110.4	111.1	64.9	86.0	107.6	93.5	64.9
March	108.3	110.9	72.0	61.2	100.1	109.7	102.0	75.0	104.5	118.3	82.8	76.0
April	107.2	108.7	79.4	55.9	124.1	109.8	89.8	77.0	102.5	136.6	68.2	92.7
May	106.2	105.4	73.7	60.1	96.7	107.4	86.0	68.2	99.3	117.0	66.8	78,3
June	90.3	95.1	52.2		91.7	113.1	105.3		108.6	117.6	73.7	
July	92.9	97.0	57.7		104.8	117.4	99.9		104.1	100.3	71.6	
August	94.3	88.7	65.1		87 5	118.9	60.9		101.6	95.4	53.8	
September	105.0	100.9	62.8		112.6	115.5	96.6		87.0	88.5	57.2	
October	103.1	101.7	58.3		108.6	110.7	97.0		97.7	94.4	55.2	
November	99.1	102.6	63.1		105.4	94.7	92.2		102.9	108.8	73.8	
December	105.1	88.0	72.9		98.2	108.2	87.5		111.8	97.7	83.8	

TABLE 13–A

Indices of Production of Malleable Iron Castings 1925–1929

(Base-Average of 1926)

Month	4 Foundries*					137 Foundries†				
	1925	1926	1927	1928	1929	1925	1926	1927	1928	1929
January	.....	97.8	81.6	73.5	88.3	.....	103.2	87.5	94.4	113.1
February	.....	102.5	73.4	76.1	92.7	.....	110.0	96.3	101.0	114.2
March	.....	128.6	99.1	89.9	100.9	.....	123.8	111.6	108.3	130.6
April	93.3	122.1	91.7	99.7	88.6	104.5	111.6	99.8	97.9	
May	93.3	111.1	86.8	103.4	101.3	101.5	100.6	97.0	103.5	
June	79.5	108.7	93.1	81.0	81.3	97.9	102.5	99.4	103.7	
July	72.7	97.5	60.1	77.0		95.4	93.3	82.0	93.2	
August	81.0	90.7	76.6	88.9		94.3	96.1	88.2	106.0	
September	85.7	97.0	68.8	85.6		97.0	98.0	78.5	96.8	
October	94.4	84.7	66.4	89.1		113.1	96.3	81.1	108.2	
November	76.8	78.2	61.7	74.6		100.8	78.7	72.2	98.2	
December	80.2	81.3	62.2	73.0		109.1	85.9	83.2	91.8	

* In the Philadelphia Federal Reserve District.
† Reporting to the U. S. Dept. of Commerce.

TABLE 14–A

Production of Steel Castings in 12 Foundries 1926–1929

(Absolute Figures in Pounds)

Month	1926	1927	1928	1929
January	13,210,356	14,812,000	11,103,118	12,071,942
February	13,139,800	14,302,000	11,340,200	12,001,000
March	14,444,000	14,404,000	10,665,500	14,551,000
April	13,058,400	9,130,000	8,652,083	15,227,000
May	12,752,351	8,692,000	10,227,363	14,943,000
June	15,458,000	10,060,629	11,746,542	13,435,000
July	12,692,000	9,784,000	10,357,190	
August	12,768,000	12,358,946	11,158,385	
September	14,766,000	9,818,000	8,027,455	
October	13,668,000	7,898,128	10,977,901	
November	11,300,000	8,563,403	10,101,790	
December	15,096,000	8,150,000	10,960,137	

TABLE 15–A

INDICES OF PRODUCTION OF STEEL CASTINGS 1926–1929

(Base-Average of 1926)

Month	12 Foundries*				130 Foundries†			
	1926	1927	1928	1929	1926	1927	1928	1929
January	97.6	109.5	82.1	89.2	102.1	91.9	78.4	98.3
February	97.1	105.7	83.8	88.7	100.8	93.9	92.4	102.7
March	106.8	106.5	78.8	107.6	121.6	108.6	98.9	120.7
April	96.5	67.5	64.0	112.5	119.7	100.1	90.6	
May	94.3	64.2	75.6	110.4	108.5	91.8	98.3	
June	114.3	74.4	86.8	99.3	104.3	92.7	96.6	
July	93.8	72.3	76.6		95.7	84.3	82.8	
August	94.4	91.3	82.5		89.6	92.0	92.4	
September	109.1	72.6	59.3		87.2	74.1	79.8	
October	101.0	58.4	81.1		87.5	66.1	92.6	
November	83.5	63.3	74.7		93.4	62.5	86.7	
December	111.6	60.2	81.0		89.6	61.8	86.5	

* In the Philadelphia Federal Reserve District.
† Reporting to the U. S. Department of Commerce.

TABLE 16–A

INDICES OF TONNAGE AND VALUE OF SHIPMENTS OF STEEL CASTINGS IN 12 FOUNDRIES 1926–1929

(Base-Average of 1926)

Month	Tonnage				Value			
	1926	1927	1928	1929	1926	1927	1928	1929
January	97.6	98.7	75.2	91.4	98.0	97.6	72.1	85.1
February	98.0	116.3	82.5	95.5	98.2	106.6	78.7	84.5
March	107.0	115.8	82.8	117.8	110.8	129.8	83.7	101.8
April	106.0	78.0	70.8	117.5	99.0	93.0	72.9	110.7
May	93.3	67.6	70.8	116.2	92.9	84.0	71.7	111.9
June	103.8	64.1	78.0	111.9	100.6	67.4	76.5	96.7
July	96.4	72.2	79.1		90.8	70.0	77.3	
August	93.1	90.1	85.2		88.3	83.9	75.3	
September	100.8	77.4	71.2		120.8	119.7	63.9	
October	105.3	62.1	81.9		104.5	109.3	78.8	
November	91.1	59.1	81.4		93.2	59.6	74.4	
December	107.5	62.1	80.8		103.0	64.6	73.1	

TABLE 17–A

INDEX OF VALUE OF UNFILLED ORDERS IN 12 STEEL FOUNDRIES 1926–1929

(Base-Average of 1926)

Month	1926	1927	1928	1929
January	105.1	51.9	61.7	73.3
February	90.6	64.7	55.1	70.8
March	105.7	55.8	38.0	78.5
April	151.0	53.1	39.6	85.2
May	131.4	54.7	61.7	68.2
June	137.7	60.9	54.7	84.4
July	113.4	55.2	47.3	
August	93.3	52.0	45.9	
September	73.6	43.1	45.2	
October	63.7	41.2	40.4	
November	62.9	41.7	55.1	
December	71.4	44.1	53.2	

See Table 16–A for value of shipments.

TABLE 18–A

INDEX OF UNFILLED ORDERS IN 12 STEEL FOUNDRIES 1926–1929

(Base-Average of 1926)

Month	1926	1927	1928	1929
January	114.9	51.4	63.4	80.8
February	81.3	66.0	49.6	79.6
March	113.1	54.7	37.0	89.8
April	162.2	53.1	39.1	92.7
May	139.7	56.4	56.8	80.4
June	137.4	61.4	42.0	102.6
July	110.2	67.3	43.6	
August	82.1	47.1	38.1	
September	67.9	41.9	48.1	
October	60.8	46.4	51.2	
November	55.9	42.4	61.5	
December	74.7	50.5	57.5	

See Table 15–A for production.
See Table 10 in text for Table 19–A.

TABLE 20–A

Indices of Raw Stocks on Hand in 12 Steel Foundries 1926–1929

(Base-Average of 1926)

Month	Pig Iron				Scrap Iron				Coke			
	1926	1927	1928	1929	1926	1927	1928	1929	1926	1927	1928	1929
January	82.4	86.0	92.0	54.1	121.0	101.1	87.3	70.4	89.2	133.6	94.8	85.0
February	104.1	83.4	84.3	61.5	105.0	95.4	102.9	67.5	85.9	130.3	103.8	72.8
March	143.0	77.4	70.1	57.5	112.3	102.1	106.5	74.6	122.8	136.3	89.7	75.3
April	115.2	83.2	55.4	44.2	103.9	105.5	89.7	60.1	137.3	157.9	70.3	72.5
May	67.1	90.2	39.9	55.2	108.4	98.6	83.3	92.1	110.0	141.1	74.1	79.0
June	93.4	121.6	50.5	43.2	96.8	86.3	75.1	100.0	94.5	124.3	77.1	64.1
July	100.2	91.9	35.0		91.9	78.9	73.1		75.7	114.7	64.2	
August	110.0	79.1	42.4		88.2	74.6	79.5		75.8	110.2	57.6	
September	106.7	74.0	38.8		91.0	74.6	74.4		99.6	118.9	78.3	
October	97.3	80.6	53.3		96.1	92.2	77.1		97.5	112.7	88.3	
November	90.5	104.8	53.5		91.0	95.1	72.0		102.2	110.9	105.2	
December	90.2	96.7	52.9		94.2	102.4	69.3		109.6	97.1	107.0	

See Survey of Current Business published by the Department of Commerce; March 1929, p. 18, and May 1929, p. 25, for Table 21–A.

TABLE 22–A

Composite Weighted Index of Production of Gray Iron, Malleable Iron and Steel Castings 1926–1929

(Base-Average of 1926)

Month	1926	1927	1928	1929
January	91.3	96.1	79.2	89.4
February	94.9	98.0	81.5	86.2
March	109.9	104.1	83.6	101.4
April	101.7	82.2	70.7	103.5
May	99.4	78.6	80.2	101.9
June	110.7	83.5	86.9	
July	95.1	74.6	79.4	
August	97.8	89.6	87.2	
September	104.1	79.6	76.9	
October	103.4	73.9	94.0	
November	90.1	71.6	84.6	
December	104.8	63.3	78.7	

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